2019

Food Waste and Depackaging Opportunities in Nova Scotia

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Funding Provided by:

Adapted for publication

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Executive Summary

Packaged food which is no longer appropriate for human consumption represents a small but significant proportion of the Nova Scotia Waste stream. We have estimated that 13,000 tonnes or more of food contaminated by packaging is entering landfills in Nova Scotia per year. Unfortunately, there were challenges gaining access to information from key food retailers in Nova Scotia. As a result, our estimate is based on population and comparators. Therefore, we recommend macro strategies to reduce this problem.

Those strategies are: provide financial support to waste haulers and food value chain intermediaries for the purchase of depackaging equipment; regulate waste producers (Industrial, Commercial, and Institutional [ICI] food providers) to strongly discourage the disposal of food contaminated with packaging in landfills; encourage the separation of food waste by type to enable the highest and best use.

To date, Nova Scotia has focused at two levels of the waste pyramid, the highest (human use through Feed Nova Scotia) and the lowest (diversion from landfill to composting). Waste haulers have reported that the high level of subsidy for compost has distorted the market and that archaic regulations have prevented better use. Feed Nova Scotia informs us that Stericycle (a multinational speciality waste handler) currently collects packaged food from retailers thereby becoming a key feedstock holder. We recommend modification of regulations to enable depackaging and use of food unsuitable for humans to be used as animal feed; if unsuitable for direct feeding, subsidies should be provided for separating and decontaminating for processing into animal feed. Rather than measuring the amount diverted from landfills, a quality of use measure should be introduced so that the environmental protection is maximized.

Given that composting is on the lower end of the waste hierarchy and that digestion via anaerobic or aerobic systems produces both energy and higher quality fertilizer for horticulture, governments and their agencies should provide financial supports for these systems at a higher rate per tonne than compost. Combined with appropriate regulations this approach should lead grocery chains and other ICIs to follow the model of Kroger in the U.S. and Sainsbury's in

the UK thereby dramatically reducing the amount of food going to landfills. Grocers should be incentivized to backhaul short-date (close to best before) product to their central warehouses and deliver to Feed Nova Scotia either directly or through Stericycle.

Divert NS should maintain its supports to redistribution for human consumption through Feed Nova Scotia. We do not recommend financial support to Feed Nova Scotia for the acquisition of depackaging equipment. The current Feed Nova Scotia space is fully utilized and the colocation of food waste with their storage, sorting and redistribution processes increase the risk of cross-contamination and food safety concerns. Professionals such as Stericycle and other waste management companies should be incentivized to collect the relatively small volume of packaged waste Feed Nova Scotia currently sends to Otter Lake.

Additional recommendations for Nova Scotia include:

- Addition of a Food Donation Care Act
- Public education to encourage at home depackaging prior; and support of a packaged food waste stream (consumer waste continues to be the largest source) either separately bagged and collected by municipal waste haulers or by the inclusion of packaged food in the green bin for separation and depackaging by the waste hauler.
- Continuing Education for retailers and retail workers on their role in waste reduction and the highest and best use principals

1 Overview of Project and Objectives

Nova Scotia’s waste management strategy was initiated in 1996, committing the province to “sustaining a healthy environment and vibrant economy”. In the time since the strategy was put into place, Nova Scotia has become a world leader for the source-separated waste management system that has allowed for significant waste diversion, particularly when compared to national averages. Nova Scotia has the lowest waste generation rate in the country. Public support for the project was one of the most significant strengths of the initiative. Placing the responsibilities of diversion with Nova Scotians themselves, allowed the public to be accountable and show pride in the success of the system.

However, new efforts are required for Nova Scotia to remain at the forefront of waste management and the growing concern globally is the issues surrounding food waste. The United Nations Food and Agriculture Organization estimates 30% of food produced for human consumption is never consumed. This problem shows the environmental, economic, and social inefficiencies present in our food system.

This report will provide a background of the current status of the food waste phenomenon both globally and locally for Nova Scotia. We will also conduct a cost-benefit analysis for recycling machinery which is called ‘depackaging equipment’. Depackaging equipment removes packaging from food matter. These machines allow for high-quality organic matter to be collected and for packaging to be separated and recycled, if possible. The three objectives of the report are as follows:

- Understand current depackaging efforts within Nova Scotia
- Determine the feasibility of adding depackaging equipment to the Nova Scotia waste management system
- Establish the current environment in the field of food waste research
- Identify strategies and make recommendations for Nova Scotia to minimize food waste

1.1 Methodology

Informal interviews with five stakeholders were conducted to build an understanding of the current situation within Nova Scotia and what is occurring in the field outside of the province. These interviews were used to direct the literature and jurisdictional reviews.

A literature review was completed using a variety of academic journal articles and government and non-government reports. The literature not only provided background information about the topic but also served to direct the jurisdictional review to locations that are active within the area.

The literature review and content analysis were conducted to inform the jurisdictional review, as key areas actively involved in reducing food waste were actively discussed. Web searches for areas determined to be of interest from the content analysis and literature review were conducted to collect information more specific to the said region. Some sources used were government policy proposals, non-profit campaigns and reports, news articles, and academic resources, where available.

A cost-benefit analysis was also conducted to determine the feasibility of depackaging equipment as a pre-conditioning step of food material recovery. An estimation of the potential increase in food waste recovery was also made using available information and estimation tools discovered in the literature. Estimates for the food waste amount was completed using the US Environmental Protection Agency’s (EPA) Food Waste Estimator tool, and the carbon offset amount was estimated using the EPA’s CoEAT model, an estimator used to determine the feasibility of anaerobic digesters. Additional estimates and values were collected from the literature that was reviewed.

Similarly, models used in grocery store chain Kroger and Sainsbury's were reviewed to identify if their circular system of using their unsaleable food product as an energy generation.

1.2 Background

The discussion surrounding the food waste phenomenon has garnered global recognition, particularly focusing on the large proportion of food being lost or wasted. Many factors contribute to food loss or waste, including but not limited to, consumer behaviour, consumer preferences, food labelling practices, production inefficiencies, and over-production. Lipinski et al. (2013) paper on reducing food loss and waste, they suggest that a sustainable food future could be achieved if a global strategy for reducing food waste was implemented. The responsibility of implementing such a strategy lies with the developed world, as over half of all food waste occurs in North America, Oceania, Europe, and industrialized Asia.

Food production is an exploitation of natural resources, contributing to climate change, loss of biodiversity, and the depletion of natural resources, so when the food produced is not consumed, a loss/waste has occurred. If the food is not re-used or recovered, resources have been removed from the system. When food decomposes in a landfill, it creates nearly ten times the amount of CO_2 equivalent when compared to composting. By removing organic waste from landfills, there is a measurable reduction in the amount of greenhouse gas emissions. For example, after the adoption of the organic waste ban in Nova Scotia, there was a drop of between 231,400 and 261,900 tonnes of CO_2eq over a 12-year span.

The Environmental Protection Agency of the United States (EPA) developed 'The Food Waste Recovery Hierarchy' (see Figure 1). The hierarchy prioritizes reduction, re-use and recovery. The uppermost levels provide the least amount of loss to the environment, economy and society (most preferred approach). The lowest level (least preferred), incineration/landfill disposal, is the least efficient and has a greater environmental consequence and lost to the food system.

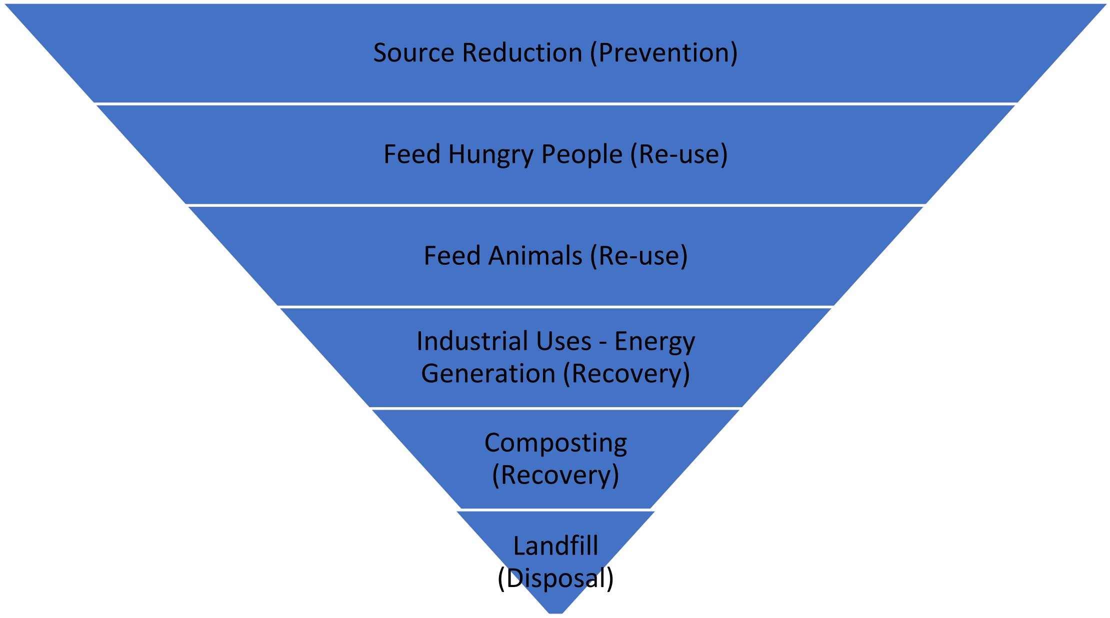

Figure 1: Food Recovery Hierarchy (EPA, 2016)

Within the European Commission Guide (2014), it was stated that ideally, waste management strategies should first aim to prevent waste generation, although, within the review of the existing food waste research, re-use is more frequently discussed. The focus was commonly placed on food donation and food redistribution, largely as a potential solution to food insecurity while also preventing 'terminal food waste' or reaching lower levels of the hierarchy.

It is important to note that there is some contention surrounding whether to place industrial uses over composting, regarding 'efficiency' or preferability.

Within Nova Scotia, there are currently no anaerobic digestors in operation, which would be the system to convert food waste into energy. This, however, is likely to change in the future with an increased push to energy alternatives and accessibility to improving technology. Experts within the waste management field have stated that they are hesitant to place one above the other as it depends heavily on the availability and composition of the food matter, as well as the infrastructure in place.

2 FOOD WASTE DEFINED

When discussing and researching the food waste phenomenon, there are a variety of terms used and it is important to specify what the terms mean within this context. 'Food loss' is used to refer to waste during the early stages of the supply chain up to distribution and retail sale; after that point, waste is referred to as 'food waste'. Depending on the institution and region, the definition of food loss and food waste can differ. When reviewing the literature, the difference in the authors' interpretations of the various terms poses a problem when studying the food waste phenomenon.

There are some differing opinions within the existing literature when it comes to a specific definition of 'food waste'. The ambiguity largely circles which stage of the hierarchy food waste occurs. The Food and Agriculture Organization of the United Nations (FAO) defines food waste as the disposal of food materials, that were intended for human consumption, which has been discarded or consumed by pests (or animals). We propose the use of the phrase 'terminal food waste', which will refer to any food matter that is disposed of in a landfill. While each level of the hierarchy has different levels of efficiency and practicality depending on the situation, disposal into a landfill is undesirable and results not only in the loss of the resources within the food matter but will also lead to methane emissions as the food decomposes.

Our society is currently stuck in a linear economic model, *take-make-use-dispose*. A fundamental change is necessary – shifting to a circular economy, which is designed to mirror a natural restorative process (shown in Figure 2). Similarly structured to the waste hierarchy, the goal is to keep nutrients within the food system and minimize loss and environmental impact.

Within Canada and the United States, 40% of food produced for human consumption is never consumed. This is largely occurring during the end stages of the food supply chain, meaning this waste would be categorized as food waste. This is largely a result of over-production and consumption.

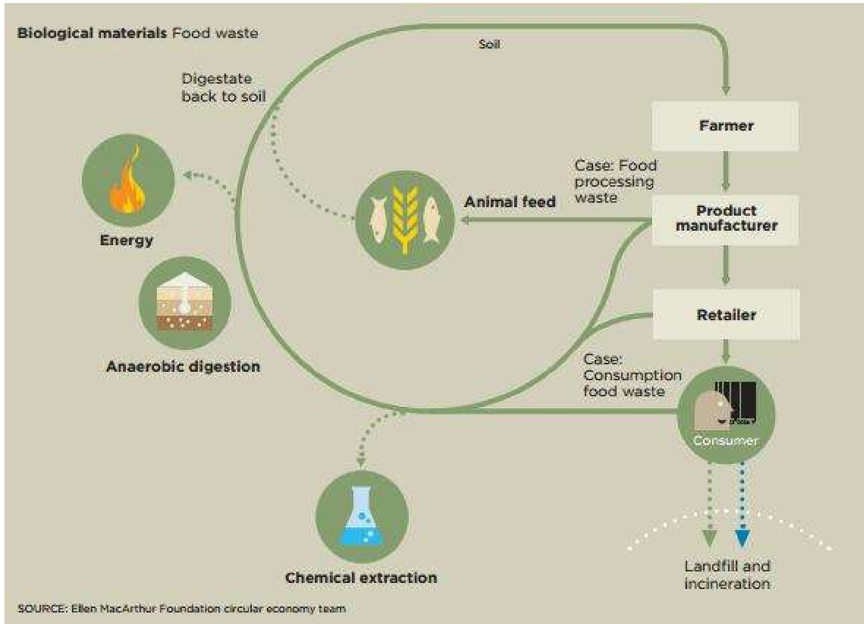

Figure 2: Food & beverage material flow pathways (Source: Ellen McArthur Foundation: Towards a Circular Economy Volume 2

2.1 Retail Food Waste

While the focus has largely been placed on household food waste, several papers noted the importance of considering the distribution and retail stages of the food supply chain. While the retail stage contributes lower amounts of food waste than other steps within the chain, retailers hold significant bargaining power, which indicates an opportunity to enact change. The power of the retail chains is particularly notable within Canada, where the market is controlled largely by four brands, Sobeys, Loblaws, Walmart, and Costco. Reducing food waste presents retailers with an opportunity to improve their sustainability and improve social standing with consumers, while also potentially reducing their costs.

Prevention is the first step in the food recovery hierarchy. The highest levels of the hierarchy are difficult to measure and rely heavily on qualitative approximation. And yet retailers have a significant opportunity, not present at other levels of the food supply chain, to influence both consumers and suppliers to prevent food waste. Education within the retail sector, for retailers as well as their consumers, has been said to be the ideal option for preventing food waste and changing the undesirable behaviours.

Retailers' choices are generally in response to consumer preferences. Consumers have shown they are more likely to purchase a product from a fully stocked shelf rather than almost bare or sparse shelves or displays. This leads to overstocking to encourage sales. Additionally, consumers have become accustomed to products, brands, and variety, all being readily available. This leads to waste caused by uncertain demand and perishable food products.

Labelling can also be a significant issue when reviewing the retail portion of the food waste phenomenon, more specifically the sell-by or best-before date. Many would deem food past the date printed on the packaging inedible, although it is likely still suitable for human consumption. Some grocery stores will use pricing incentives to attempt to sell foods close to their labelled date, but many consumers may not choose to purchase that item as they deem it to be of lower quality.

Providing clear date labelling, unified across all products, to the consumer, could help them properly understand and use what they have bought. Some have suggested adding 'freeze-by dates'. Improving food labelling can help to educate consumers, but the use of innovative packaging and dynamic shelf life are also noted as options available for the retailer to reduce their food waste amounts.

Some retailers take advantage of donating unsaleable products to the food bank to reduce food waste. Redistribution of this food to the needy helps to improve retailers' social images as well as alleviates them of the responsibility of the disposal of the product. Recovery for human consumption is shown to be a possible use for edible food that has had damage to its packaging, does not meet quality standards, is blemished or unpurchased. Cicatiello et al. (2016) identified five types of retail food waste and possible uses, as shown in Figure 3.

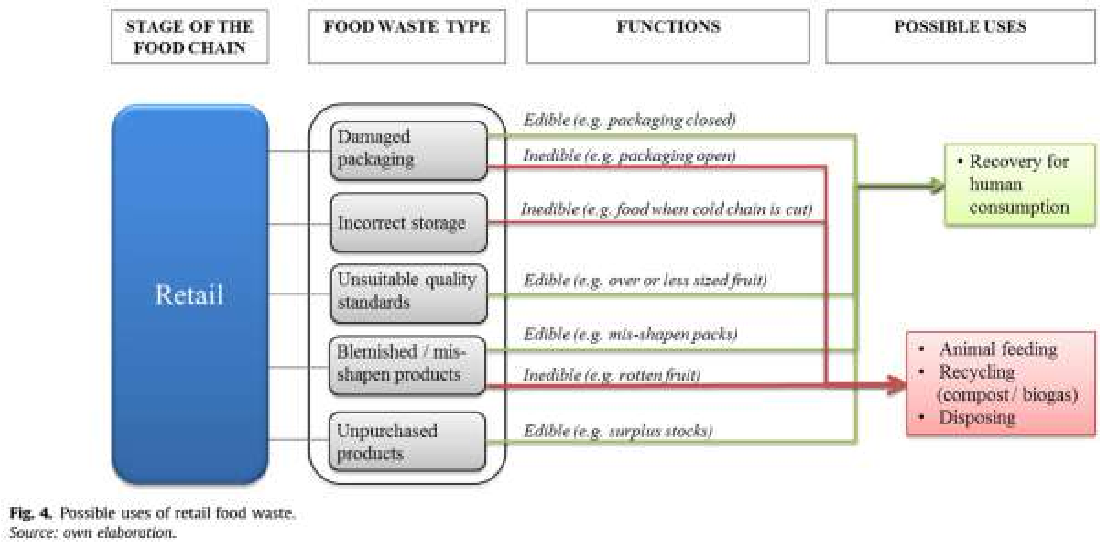

Figure 3: Possible uses for retail food waste (Cicatiello et al., 2016)

3 JURISDICTIONAL REVIEW

3.1 NORTH AMERICA

3.1.1 Canada

In Canada, food waste costs are estimated at over 100 billion dollars per year in direct and indirect costs. In 2012, 6.7 million tonnes of organic waste was generated residentially, with food waste accounting for 28%. National households are by far the largest waste generator at 47% of food waste across the food supply chain (see Figure 4). ICIs generated an estimated 2.78 million tonnes of food waste nationally in 2012 (or 34% of ICI organic waste). These values were calculated by the Commission for Environmental Cooperation in their report on the characterization of organic waste in North America. In it, they identified the ICI generated organic waste as the “largest potential target for diversion to industrial uses”.

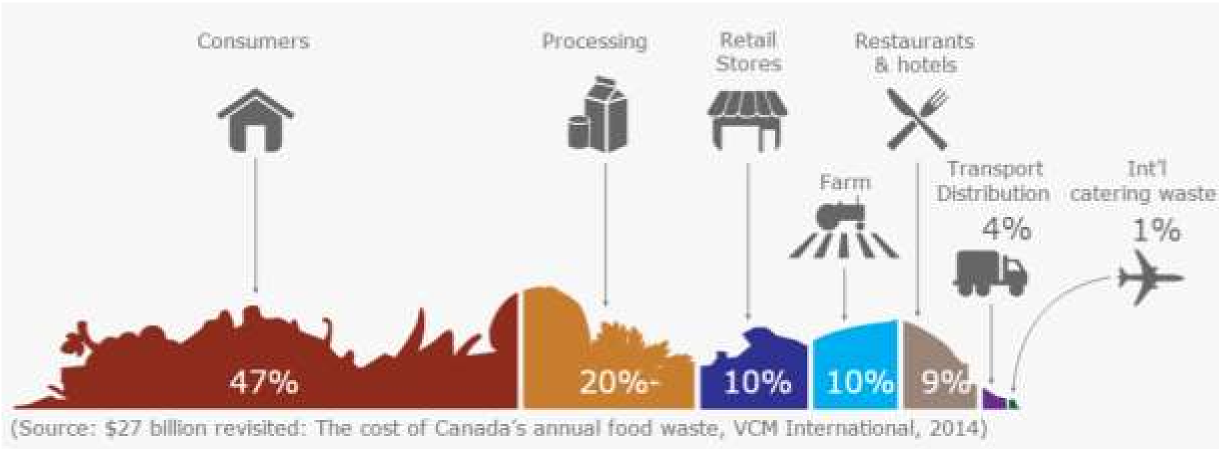

Figure 4: Distribution of Canada's Food Waste Across the Supply Chain

No national policies are focusing on food waste within Canada, provinces and territories are responsible for developing their own policies and guidelines. The federal government is in the works, however, to develop a proposed Food Policy for Canada, which will address food waste, along with other food-related issues. Presently, Nova Scotia and Prince Edward Island are the only provinces to implement an organic waste disposal ban, with Quebec and Ontario following suit by 2022.

Canada's National Zero Waste Council (NZWC) began in Vancouver, BC, in 2013, and works in collaboration with the Federation of Canadian Municipalities. The organization's mission is to "act collaboratively with business, government and the community, at the national and international level, as an agent of change for waste prevention and reduction in the design, production and use of goods."

NZWC has developed a Food Loss and Waste Strategy for Canada. It was developed through their stakeholder engagement program and outlines key findings and recommendations on how Canada can combat food waste nationally. The council has also called on the federal government to support a tax credit to encourage businesses to donate would be food waste to those who need it. Ontario, British Columbia, and Nova Scotia have initiated a Farmers Tax Credit for food donations made, but there is presently no credit in place for retailers.

3.1.1.1 Nova Scotia

Nova Scotia has been a global leader in waste diversion for over 20 years, thanks to a stringent source separated waste management system. Waste disposed of per person in Nova Scotia has seen little reduction since 2004, although it is less than half the National average of 777kg per person. Food waste appears to be the logical next area of waste for Nova Scotia to focus its historically successful waste diversion efforts.

Valley Waste was willing to share photos of a delivery of organic waste collected from two grocery stores in the county. The representative informed us that the food collected from the grocery stores is typically free from prepackaged foods or meat products. Valley Waste understands that (or more) of the grocery stores donate unsalable food to the zoo located in the county and the packaged products are sent out of the region for recycling.

A notable gap identified in Nova Scotia's regulation is the lack of a Food Donation Care Act. All provinces, except Nova Scotia and Quebec, have a Food Donation Care Act. The act frees persons or corporations from any liability for the foods donated. Nova Scotia does have a Volunteer Service Act in place, in which it states:

> **"Food or sundries to person in need**
>
> **4A** A volunteer is not liable for damages incurred as a result of injury, illness, disease or death resulting from the consumption of food or the use of sundries by a person in need unless it is established that
>
> (a) the injury, illness, disease or death was caused by the gross negligence or the wilful misconduct of the volunteer; or
>
> (b) the volunteer knew that the food or sundries were contaminated or otherwise unfit for human consumption or use at the time of donation or distribution, respectively. 1992, c. 34, s. 2."

- Volunteer Services Act, Chapter 497, 1992

Given that the act refers to the provider of the donation as a volunteer, rather than a term such as persons, which could be interpreted to include businesses and corporations, the act may not extend to a grocer donating food to those in need. Some grocery chains have entered into contracts with the food banks to avoid any potential liability issues, but the addition of a Food Donation Care Act, similar to the other Atlantic provinces, could be an opportunity to remove a barrier for businesses in the province who wish to donate.

Nova Scotia currently has a Farmers Donation Tax Credit in place, where farmers can donate surplus or unsaleable crops to a registered food bank and received a tax credit of 25% of the products market price. This incentivizes farmers to harvest the unsaleable crop, rather than leave it in the field. Extending this to include food retailers may be another potential opportunity to improve food donation.

Nova Scotia is faced with a problem that is echoed throughout the literature when discussing redistribution or donation of food. Food banks are limited on capacity, transportation, and storage space for perishable and fresh items. Additionally, the isolation of many communities adds another barrier not only for the collection of donated food but also distributing it to those in need.

3.1.1.2 Vancouver, British Columbia

In 2015, Vancouver began enforcing an organics ban similar to the one already in place in Nova Scotia. Metro Vancouver offered resources to household waste generators as well as ICIs. Among these resources, de-packaging services were offered to help retailers properly handle their organic waste to meet the requirements of the new ban (Metro Vancouver, 2015).

One such service is Waste Control Services, located in Coquitlam, BC. The company serves as a waste hauler for ICIs while also offering residential services and states that they are dedicated to Zero Waste initiatives and they highlight multiple practices they have that support these initiatives on their web page, including food depackaging for reuse as fuel, feed, and soils.

Redux Nutrition is another BC based company, located in Vancouver. This organization collects pre-consumer organic materials from producers and separates them from any packaging to instead use the products as animal feed. The method of which they depackaging the waste is not clear from the information available online (West Coast Reduction, 2019). Vancouver is home to another organization that offers depackaging services. Revolution has two locations one in Vancouver and a second in Surrey. They provide a variety of services focused around the recycling and recovery of products and state they have technology that allows them to depackage organic materials from any packaging except glass (revolution, 2019).

Metro Vancouver also provided a review of on-site options available to waste generators impacted by the ban. Table 1 shows the four options that the organization reviewed and considered to be capable of processing the organic waste on site. Storage is temporary storage of the waste prior to pick up, pre-treatment is thermal or mechanical treatment of the waste to reduce volume, aerobic digestion is the microbial breakdown of the waste within oxygen, and anaerobic digestion is the breakdown in the absence of oxygen (Metro Vancouver, 2014).

Table 1: Metro Vancouver's On-Site Management Options

#	Option	Sub-Option
1	**Storage**	Conventional
		Specialized
2	**Pre-Treatment**	Dewatering
		Dehydration
3	**Aerobic In-Vessel**	Small (approximately 10 tonnes per year)
		Medium (approximately 100 tonnes per year)
		Large (approximately 1,000 tonnes per year)
4	**Anaerobic In-Vessel**	Medium (approximately 500 tonnes per year)
		Large (approximately 1,000 tonnes per year)

Table 2 shows the summarized comparative analysis of each of the systems, ranking them from mediocre to best across 12 variables (Metro Vancouver, 2014). The definitions for each of these variables are listed below the table. The optimal system would be heavily dependent on the operation itself and the objectives of the organization with regards to their waste diversion and management.

Table 2: Metro Vancouver's Comparative Analysis of On-Site Management

Option	Weekly Capacity	Capital Cost	Annual Maintenance Cost	Footprint	Materials Accepted	Time commitment	Corporate Sustainability Benefit	Odour control	Output Material	Maintenance	Capital	Process Time	Installation Requirements	Capacity	Electricity Requirements
Conventional Storage	Depends on hauling	Up to $1,000	Minimal	◕	●	●	○	○	○	●	●	●	●	◑	●
Specialized Storage	Depends on hauling	$4,000-6,000	Minimal	◕	●	●	○	◔	○	●	●	●	●	◑	●
Dewatering	Up to 400,000 kg/week	$25,000	$250	●	◑	◕	◔	◔	◔	◕	◑	●	◑	●	◔
Dehydration	Up to 14,000 kg/week	$27,000-50,000	$200	●	◕	◕	◑	◑	◑	◕	◑	◕	◑	◕	○
Small Aerobic In-Vessel	150 -3,500 kg/week	$18,000	$400	◕	◑	◑	◕	◑	◕	◑	◕	◑	◕	◔	◑
Medium Aerobic In-Vessel	700 -8,000 kg/week	$30,000+	$600	◑	◑	◑	◕	●	●	◑	◑	◔	◑	◑	◑
Large Aerobic In-Vessel	2,000-18,000 kg/week	$450,000	$500	◔	◕	○	◕	◕	◕	◑	◔	○	◔	●	◑
Medium Anaerobic In-Vessel	5000 - 20,000 kg/week	$240,000+	$14,000	◑	○	◔	●	◑	◕	○	◔	○	◔	◕	●
Large Anaerobic In-Vessel	20,000 kg/week	$825,000+	$10,000	○	◔	○	●	◕	◕	○	○	○	○	●	●

Icon	○	◔	◑	◕	●
Score	Mediocre	Fair	Good	Better	Best

"Footprint – A higher score was given to options that took up less space overall.

Materials Accepted – A higher score was given to options that can accept a wider range of materials.

Time Commitment – A higher score was given to options that require less labour to operate.

Corporate Sustainability Benefit – Low scores indicate that the perceived corporate sustainability value of a given option is relatively low. High scores indicate an environmentally conscious option that could boost positive corporate image and improve educational opportunities.

Odour Control – A low score indicates odour may still be an issue if proper process control is not implemented. A high score indicates advanced odour control technology as part of a given option.

Output Material – A low score indicates that the output material is still generally raw food scraps. An intermediate score indicates some level of decomposition. A high score indicates ready-to-cure compost material or soil amendment.

Maintenance Cost – A higher score was given to options with lower maintenance costs.

Capital Cost – A higher score was given to options with lower capital costs.

Process Time – A high score indicates more or less instant processing of organics. A low score indicates that process time may take upwards of several weeks.

Installation Requirements – A high score indicates that no additional infrastructure is required for installation. A medium score may mean minimal infrastructure is required, such as a hook-up to drainage, ventilation or shelter. A low score indicates installation may require more expensive infrastructure such as concrete pads.

Capacity – A higher score was given to options that could handle more organics on a weekly basis.

Electricity Usage – A high score indicates no electricity usage for a given option. A low score indicates very high electricity usage."

- Metro Vancouver, On-Site Organics Management Options Review, 2014

In 2017, two years since the implementation of the organics ban in Vancouver, compost from organic waste increased by 30%, yet diversion rates are still not at the goal set by Metro Vancouver. The objective for 2020 was for the city to have an organics diversion rate of 80%, yet the 2017 reports showed they had only reached 63% (Pawson, 2017). The city is committed to reaching the 80% diversion rate by 2020 and setting new goals for 2040.

3.1.1.3 Ontario

Ontario has recently announced that they will be shifting to a circular economy (Figure 5), by managing their resources more effectively to benefit the environment and the economy. With over 2.2 million tonnes of terminal food waste occurring in the province, the province proposed a food and organic waste framework in November 2017. The document outlines an action plan, as well as a policy statement. Most notably, the document states that the province will develop and implement a food and organic waste disposal ban, which will be added to the Environmental Protection Act.

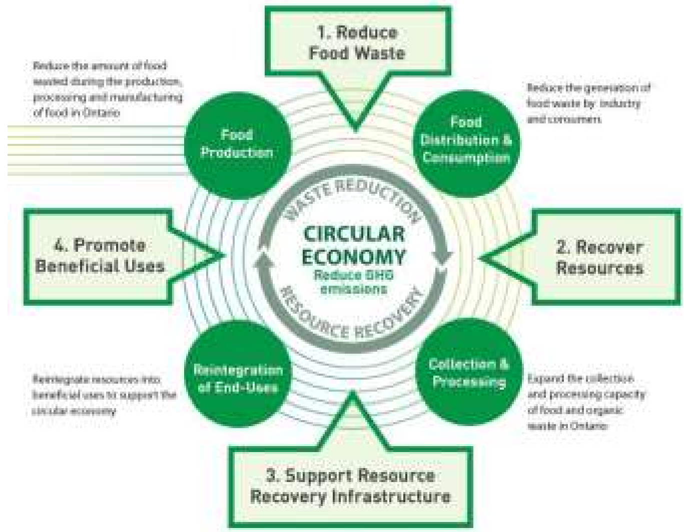

Figure 5: Food in a Circular Economy (Ontario Policy Framework)

Ontario also has a feed-in-tariff (FIT) program, which was developed in 2009, that provided a preferential revenue stream to electricity generated from sources such as biogas from anaerobic digestion of organic waste. Provincial regulation 101/94 requires any municipality with a population of over 5,000 to provide home composters to residents, with green bin collection in municipalities with a population greater than 50,000.

The province has also recently begun a new initiative especially focused on improving food recovery in the commercial sector. The project, titled “Improving Food and Food Waste Recovery in the Non-Residential Sector Through Co-operative Collection” is being run by the Recycling Council of Ontario and aims to aid in collaboration between the waste generators and waste services. The primary goal is to build a successful collection model that will not only be cost effective but also allow for maximum food recovery.

The proposed program, illustrated in Figure 6, would have one centrally located site that would collect all the food waste and distribute it to the appropriate processing locations. Products that are still edible would be stored and then transported to a food recovery partner and products requiring depackaging would be processed and sent along to the appropriate location.

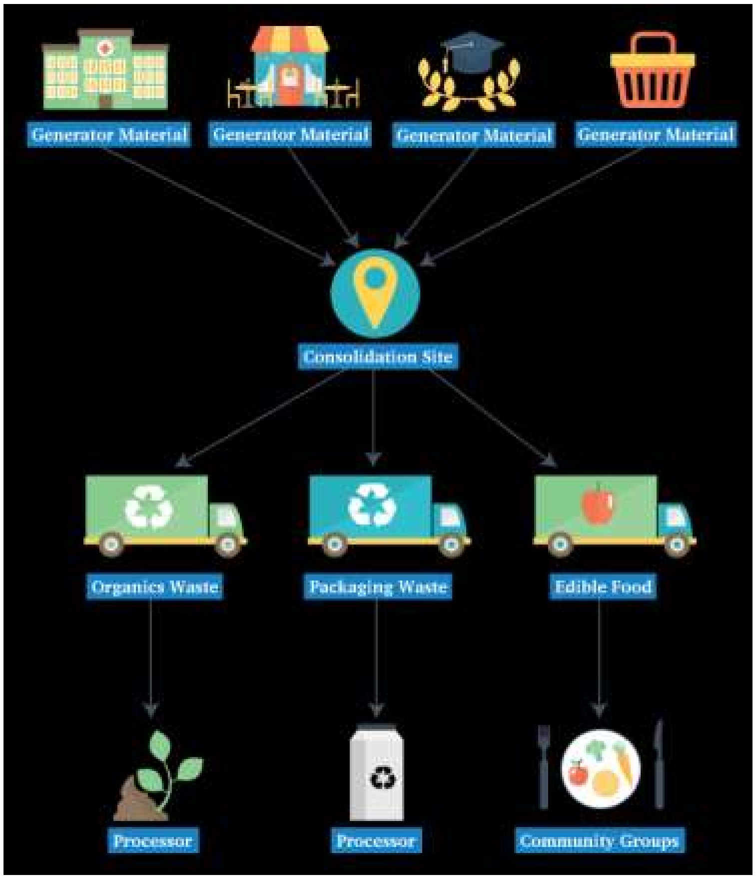

Figure 6: Proposed Commercial Food Waste Collection Co-Operative (Ontario Policy Framework)

It is the goal that this system would be both efficient and convenient for service providers and waste generators. The project aims to publish a completed report in December 2018, but the council has yet to publish any new reports as of June 2019. Full details on the Recycling Council of Ontario's work can be found on their website.

3.1.2 The United States of America

In 2015, the Environmental Protection Agency (EPA) and the Department of Agriculture set the country's first food waste reduction goal of 50% reduction by 2030. While no federal policies are accompanying this goal, states and local municipalities have been making strides in organic waste diversion.

Residential organics collection programs can be found in 19 states and are typically curbside organics pickup. These programs are estimated to serve 2.7 million households in approximately 200 communities. As is the case in Canada, the municipal solid waste system is developed by the municipalities and counties and not at a state or federal level. Some states have imposed organics bans, including commercial organics bans in California and Massachusetts.

ReFED is a data-driven US non-profit that has committed itself to reduce food waste. Along with developing a comprehensive action plan to reduce food waste by 2020 called The Roadmap, their site also has a variety of interactive infographics and data reports. They aim to engage stakeholders at all levels of the food supply chain and provide action guides for food retailers, food services, and philanthropic support.

ReFED also partnered with Harvard Food Law and Policy Clinic June 2018, to host the US Food Waste Summit. They focused on six topics over the duration of the summit.

- Accelerating Date Label Standardization
- Bridging the Food Waste Research Funding Gap
- Building Infrastructure for Farm Level Surplus
- Exploring Food Waste Reduction Packaging
- Incentivizing & Supporting Healthy Food Donation
- Organic Waste management & Policy

3.1.2.1 Massachusetts

Massachusetts implemented a commercial organics ban in 2014, requiring all commercial businesses producing more than one ton of organics waste per week to re-use or recover the material, thus avoiding terminal waste. When speaking with a representative from the Centre of EcoTechnology in Massachusetts, he stated that they started with the commercial waste recovery to help build the infrastructure and resources before enacting a residential organic ban.

The Centre of EcoTechnology (CET) developed the RecycleWork Massachusetts program with the state government to serve as a resource for industry to become environmentally sustainable. The non-profit serves as a facilitator for government and industry to work together to identify gaps and opportunities to build engagement and networking throughout all stakeholders.

They offer a variety of services and resources to the business community, and while they do work with food recovery and re-use, they also have a keen interest in prevention. They have found that focusing on multiple levels of the hierarchy yields the best results. The representative said the prevention stage of the waste hierarchy is where they see the most innovative solutions, with a variety of technology-based platforms that aim to reduce food waste at the source and empower the retailers to employ tactics in store with relative ease.

The representative also stated that Kroeger, a US grocery chain, recently began collecting their unsaleable food and placing it back on delivery trucks after they deliver fresh food. The truck then returns the food waste to the distribution centre, where it is placed in their on-site anaerobic digester. This solution doesn't add any miles to the food's footprint, given that the truck would be returning to the centre regardless, and they are now able to generate their own renewable energy. This is similar to the larger system previously mentioned when discussing Ontario's new pilot program for commercial food waste reduction.

3.1.2.2 California

California's battle against food waste is largely championed by CalRecycle, the state government's Department of Resource Recycling and Recovery. With six million tonnes of food waste per year, California has set an ambitious goal of 75% diversion by 2020.

It was noted in the literature that California might stand out when comparing to many of the other states because the cost of landfilling is higher there than in many other locations, due to a large amount of agricultural land and heavily populated city centres. This provides the state with an increased incentive to divert from landfill, particularly when the organic matter can be better used as green energy or fertilizer/compost for agriculture.

As mentioned, California is one of the states that has placed an organic material ban on non-residential waste generators. Some regions within the state have enacted a full organics ban for both residential and non-residential. San Francisco has had its mandatory recyclables and compostable collection in place since 2009. Along with separate bin collection, they rolled out an intensive outreach program, which allowed the city to achieve the highest diversion rate in North America at 80%.

3.1.3 Europe

3.1.3.1 France

France produces approximately 1.3-1.9 million tonnes of food waste per year and in the battle against food waste, France has taken an aggressive stance, particularly against retailers. Deciding against a voluntary approach, France has become the first country to ban terminal retail food waste. The law was passed by the French Senate unanimously in 2016. Those behind the campaign now hope to encourage the EU to pass similar legislation. The grocer is required to donate unsellable food or face a fine. Marie Mourad, a researcher at the Centre for the Sociology of Organization in Paris, completed a report in September of 2015 that outlined 36 policies and regulations, that if implemented, would greatly reduce the food wasted in the food value chain (Mourad, 2015). The comprehensive list of recommendations offers not only solutions for France, but for many nations.

3.1.3.2 The United Kingdom

In the United Kingdom, 7.3 million tonnes of food is wasted, with 71% of food waste occurring in households. In 2016, the Courtauld 2025 Commitment was launched, which is a voluntary agreement for all members of the food supply chain to commit to reducing food waste by 20% by 2025. Unfortunately, as it is voluntary, the commitment does not have the same strength as a regulatory approach would have.

The Waste & Resource Action Program (WRAP) is a UK based charity that focuses on achieving a circular economy. In 2007 they launched the “Love Food, Hate Waste” campaign, which aims to reduce food waste in the UK. The program provides information and resources on the problems caused by food waste, as well as what changes can be made to improve the problem.

4 DEPACKAGING INTERVIEWS WITH INDUSTRY STAKEHOLDERS IN NOVA SCOTIA

Due to a fire on campus during the time of research, original notes and questions were lost. Below are the summaries of the interviews that were recovered from the fire. All interview notes were originally reported in the master's thesis of the student researcher on this project (MacDonald, 2019).

4.1 VALLEY WASTE, ANDREW GARRETT, REGIONAL COORDINATOR

In addition to the photos shared by Valley Waste, they also reported that within their region industrial, commercial and institutional (ICI) waste accounted for 14% of the organic waste collected during the 2016-17 year This number (reported in metric tonnes) has actually been decreasing since 2012. The representative did not believe that retailers were depackaging on site, and thought that there might be a private company that was offering depackaging somewhere in the Halifax area. We were unable to confirm if there were any such operations.

Table 3: Organics collected by Valley Waste

YEAR	ICI ORGANICS	TOTAL ORGANICS	ICI %
2012-13	1873	10206	18%
2013-14	1948	10488	19%
2014-15	1813	10764	17%
2015-16	1663	10788	15%
2016-17	1434	10580	14%

The table does not include all organic waste collected from ICIs, as one of the haulers the municipality has collects three streams of recyclables at one pick up. The representative assumes that the ICI contribution is somewhere between 15-20% of the total organic waste collected.

Additionally, the representative reviewed four separate grocery chains in their area for their three-month waste collected from their on-site compactors. The four stores averaged 18.06 metric tonnes for the months of November, December and January. One store was much lower than the other three, generating 11.08 tonnes during the three-month span. He was unsure of whether this was due to the busyness of the store, management practices, or if they have an alternative destination for their organics that the other stores do not have in place.

4.2 Private Waste management hauler, Miller Waste, Jeff Traver

Some barriers they have noted are some industry-specific regulations. For example, there is a barrier preventing the re-use of collected for animal feed. The representative stated that the Canadian Food Inspection Agency (CFIA) considers that food becomes garbage once it has entered the waste hauler's truck, and then becomes unusable as feed for animals. The company has investigated potentially re-using the collected food waste for use as feed in the local mink and fisheries industry but are unable to do so as a result of this ruling by the CFIA.

Additionally, within the Halifax Regional Municipality (HRM), waste haulers are unable to offer depackaging services to their commercial customers. The representative stated that stores are required to instead separate the packaging and food waste manually. He said that while depackaging equipment would save money for the stores there wouldn't be an increase in waste diversion since stores are already required to sort within their store.

Some opportunities the company has identified is the use of anaerobic digestion for organic waste that is not ideal for composting. Commercial organic waste accounts, by the representatives, estimate, for approximately 50% of the waste they process. This commercial waste has an increased amount of leeching and needs more fans to dry it out for proper composting. Yard waste and green bin waste is very good for composting, while high liquid waste would be better suited for anaerobic digestion. Many of the depackagers commonly used will produce an output that would require additives as it is too wet from composting.

Miller Waste is moving forward to meet these opportunities by investing in the new equipment. They will be having a depacker delivered to support their on-farm digestor. This is also a move for the company to match its Ontario location that has similar technologies in place.

He did note that anaerobic digesters are not perfect, but that there have been significant improvements, with some systems being able to handle higher contaminant levels, something that has been an issue within agricultural digesters in the past.

4.3 SF Rendering

A local rendering company has been engaging in some manual depackaging at their facility. They were depackaging food products and selling the recovered food as animal feed to mink farmers in the province. Unfortunately, the province's mink industry took a downward turn in 2016. As a result, SF Rendering has not depackaged any products for over 12 months. Moving from the mink feed down to rendering for other uses means that the end product would not be worth the inputs. The representative stated that their output would never be able to compete with composting because the composting industry is heavily subsidized. He stated that it felt as though the composting industry is government run because of the funding they receive.

When asked about whether regulations were a barrier for food waste depackaging, he stated that they were not. Once they learn the regulations that are easy enough to comply with. The main barrier he identified was that composters are preferred by the province making it more difficult for them to successfully compete within the recycling industry.

4.4 Johnston Trucking

The representative from Johnston Trucking has been within the depackaging world for over 10 years. They do liquid depackaging using a depackaging machine that perforates and squeezes the products out. Unfortunately, not all the packaging that goes through the machine is able to be recycled.

Their main customer for the depackaging portion of their business is Agropur, an ice cream manufacturer. Agropur was formally Scotsburn Dairy when they began depackaging for the company. While Johnston is currently depackaging ice cream, they used to depackage ice cream and waste milk. They were able to dilute the ice cream with the milk and would deliver it to a local pig farm as feed. When the Scotsburn company was sold, the milk portion of the business was relocated and the ice cream manufacturing staying within the community. The representative from Johnston does not know where the waste milk he once used for diluting the ice cream is now going. The ice cream, undiluted, is not suitable for pig feed as there is too much sugar in the ice cream. Now the depackaged ice cream is sent to an agricultural anaerobic digestor in Shubenacadie, Nova Scotia. This is a lower level of the waste recovery hierarchy than as animal feed.

The business does have other clients that require food depackaging, but that is typically on a more casual, as needed, basis. This additional waste is either taken to a local composting facility or to the landfill depending on the type of material. The representative stated that there is very little incentive for retailers and manufacturers to use his services. The industry is too tight-lipped about where their waste is going so it is difficult to track the availability of food waste. The representative is unclear of whether depackaging is happening in-store or if everything is going to landfill or on-site compactor. Due to a lack of motivation from waste generators and no substantial growth in depackaging demand Johnston Trucking decided not to invest in upgrade equipment for their facility. The representative felt that to motivate retailers, regulations would be necessary.

4.5 FEED NOVA SCOTIA: CIRCULAR MODEL

In the spirit of the circular models shown throughout the report above, Feed Nova Scotia is a potential centralized location to house the depackaging equipment. They would however still be required to hire outside waste haulers to transport the organic waste from their facility to a composting site. There are costs associated with this, as well as with the transport of the products from retail locations to the Feed Nova Scotia distribution centre. If the retailer's tax credit similar to that of the farmer's tax credit) were to be put in place, this might incentive retailers to incur this cost themselves. The systems may also provide retailers with a reduction in their waste disposal costs.

Feed Nova Scotia provided a significant amount of information related to their depackaging processes via a Divert NS representative and a follow-up interview with a senior staff member was undertaken by a member of the research team. This interview included a tour of the Wright Avenue, Burnside facility.

Feed Nova Scotia receives approximately 200 tonnes of food which they are unable to redistribute. Primary causes for unsuitability are past possible reuse date (not best before or expiry date, Food Banks Canada provides standards as to how long good are edible beyond those dates [up to 1 year]), damaged packaging such as badly dented cans or cut boxes or bags. Of this material, Feed Nova Scotia sends approximately 110 tonnes of canned goods to Otter Lake Landfill each year. Some of the remaining product is manually depackaged - they estimated 16 tonnes. The remainder is picked up for reuse by other organizations.

The total figure of 126 tonnes of food which requires depackaging in order to divert it from the landfill is well below the minimum required to make depackaging financially viable or sensible. However, this low figure raised the question of: Where is the other 99% of packaged food waste we have estimated that Nova Scotia produces going?

As Feed Nova Scotia does not have sufficient feedstock to make a depackaging system viable, the interviewer turned to the potential for Feed Nova Scotia to become the central hub for packaged materials unsuitable for redistribution for human consumption. The first hurdle to this possibility is its mandate. Feed Nova Scotia' mandate is to reduce food insecurity. They achieve this through complex means of collecting and redistributing surplus and short-date (unsaleable) food to food banks, shelters and "soup kitchens". Becoming a diversion coordinator for food which has no potential for human use would require an addition to this mandate and governance considerations. However, it seems that Feed Nova Scotia is a growing and successful social enterprise which could develop such a program if warranted.

This raises the question of facilities. Feed Nova Scotia has a large warehouse in Burnside which had been previously used by a food distributor. It has been renovated for their purposes via the addition of refrigeration and freezer capacity and other modifications. It is a significant upgrade from their previous headquarters. As Feed Nova Scotia develops stronger relationships with more grocers and other ICI's as well as Food Banks Canada, they receive and redistribute more food each week. The facility is efficiently set up to handle regular volumes of both perishable and non-perishable goods while maintaining food safety requirements. Four months per year (November-February) the facility is full of non-perishables to the extent that in 2018 a refrigerated truck was kept onsite for Christmas related goods. In the remaining eight months of the year, it is possible to clearly segregate compost and other potentially harmful waste products from food for redistribution (procedures are implemented in the high season to minimize onsite waste). The facility uses both electricity and natural gas, therefore, would be a good candidate for a depackaging/digestion system which would supply biogas for heat.

However, an increase in the volume of packaged waste to the minimum financially viable level of over 1,200 tonnes would not be possible without disrupting operations. There is exterior space where a depackager and digester could be located but the space is not large enough to provide staging space for feedstock or a sequestered holding space for the depackaged food. Depackaged food awaiting use in a digester or trucking offsite would pose a significant food safety threat. Feed Nova Scotia would have to set up depackaging and digestion in a separate location.

A new social venture led by Feed Nova Scotia is a possibility but given further information provided by Feed Nova Scotia, it does not appear to be a logical option.

Both the question and the answer appear to require further investigation of the value chain. Feed Nova Scotia collects less than 1% of the expected packaged waste. We know from other research that about 47% is likely produced in homes. Some of this material is placed in the boxes at grocery stores and other locations by consumers. This is collected by Feed Nova Scotia. Feed Nova Scotia also collects some material from Sobeys, Loblaws, Costco and other warehouses. Consumers put expired and other inconvenient product in the household waste stream (this product ends up being handled by waste haulers). Small amounts of waste are being diverted by farmers and the waste haulers.

We inquired as to the nature of the 100 tonnes of canned goods that Feed Nova Scotia currently sends to the landfill. In the course of the description, the Feed Nova Scotia representative informed us that a significant proportion of the product comes from Stericycle. Stericycle is an international organization which handles medical and other specialized waste. They recover unsaleable merchandise from retailers including expired goods as well as recalled goods. According to Feed Nova Scotia, Stericycle provides a significant amount of packaged food to Feed Nova Scotia but that about 25% of the packages are damaged beyond Feed Nova Scotia standards for redistribution.

5 DEPACKAGING EQUIPMENT

The expansion of the organics recycling industry provides society with a significant opportunity to improve the collection and quality of food waste. The presence of contaminants such as paper, plastic, cardboard, or glass can prevent the food waste being used in recovery systems such as anaerobic digestion, feed for insects or animals, or compost. De-packaging equipment has been developed to alleviate this issue and remove the packaging while still recovering high-quality organic material.

Depackaging equipment (sometimes called deconditioning) is a preconditioning system that uses a process of compression, shredding, agitation and screening to remove food material from various packaging materials. These systems produce an output that is high-quality and free of contaminants.

De-packaging equipment is useful for anaerobic digestion (AD) and conditioning organic material to be used as animal feed or compost. If the food waste is not separated from the packaging, the food product is likely to end up in a landfill as it would not be suitable for the alternative food waste handling options. Not only is that resource now lost, but it now leads to the production of methane gas (Ribić et al., 2016). In the UK, packaging contaminates in food waste can reach upwards of 20%, with supermarket waste containing the most. The presence of other materials such as metal or glass would leave the matter unusable as feedstock and can cause issues with the AD equipment. Therefore, the de-packaging of food is arguably the most important step in the proper management of food waste.

There are few anaerobic digestion facilities in operation currently in Nova Scotia, in 2016 the Organics Management Council Report recommended that a program introduce anaerobic digestion processing capabilities be initiated to improve cost performance and compost quality (Reid, 2016). Additionally, in July 2018, Halifax Regional Council staff were asked to a service provider for organics management and processing with capabilities for both anaerobic digestion and aerobic composting (Keliher, 2018). This shows that there is a potential for anaerobic digestion to become a utilized system of waste diversion in Nova Scotia. Given the importance of depackaging in such a system, and its usefulness in composting, which the province is currently using for waste recovery from landfill disposal, the equipment appears to be a potentially useful investment.

As noted by Fisgativa et al. (2016), there have been very few studies reviewing the process of package deconditioning. Anaerobic digestion is considered to be the best technology for the use of the food waste and has the highest potential for energy creation (Fisgativa, Tremier, & Dabert, 2016; Zhang, Su, Baeyens, & Tan, 2014). The high variability of the waste collected can cause uncertainty for the anaerobic digestion systems (Fisgativa et al., 2016).

As stated previously, growth in the recycling industry has led to innovation and diversity in recycling technology. There are several models of depackaging machines to fit a variety of needs. WRAP UK and RecyclingWorks Massachusetts are two organizations that work with the government and businesses to reduce waste and improve sustainability. They have each conducted reports of available depackaging equipment. These are shown in the table below and available in more detail in the appendix.

Table 4: Summary of Available Depackaging Equipment

Company Name	**Model name**	**Food handled**	**Packaging handled**	**Capital Cost (CND dollars)**
Atritor Limited	Turbo Separator TS2096	Mixed grocery, household products, cosmetics, etc.	Metal, plastic, carboard	100,000-195,000
Atritor Limited	Turbo Separator TS3096	Mixed grocery, household products, cosmetics, etc.	Metal, plastic, carboard	126,000-220,000
Brand GmbH	Food Waste Processing Line	All	All, excluding pallets	433,980
Brask Entreprises	High-Density Extruder	Wet food waste and liquids	Paper, plastic, aluminium, tin, steel, etc.	Varies
Brask Entreprises	Xcycler	All	Varies	Varies
Brask Entreprises	Xtractor	Liquids	Plastic, tin& aluminum cans, and paper containers	Varies

Ecoverse	Tiger HS 640	Consumer food waste, packaged food, cafeteria waste, food production rejects	Cans, metal, plastic, paper, cardboard	604,831
JWCE	ZWM	Liquids, dairy, canned foods, boxed foods	Cardboard, plastic bottles, metal cans	131,485-164,356
Scott Equipment	Turbo Separator	All	All	263,048
Sebright Products	High-Density Extruder	Wet food and liquid waste	All	92,040-657,425
Sebright Products	X3Cycler	Liquid Products	Aluminum cans and bottles	92,040-657,425
Sebright Products	Xtractor	Liquid Products	Aluminium cans, plastics bottles, and other liquid containers from 0.5 to 4 litres	92,040-657,425
Veolia	Ecrusor-1000	Mixed food and beverage waste, and landfill diverted organic waste	All	Varies

Given the versatility of the Scott Equipment in addition to the system being produced in North America, we will be using this equipment for the cost-benefit analysis section of this report. However, a detailed description of the Veolia Ecrusor is available in the Appendix for review. Additionally, the reports conducted by WRAP UK and RecyclingWorks Massachusetts are also available in full in the Appendix.

5.1 Depackaging Systems in Operation

Depackaging systems are most commonly used as a preconditioning step in anaerobic digestion and composting, although much less frequently in composting, given that the liquid content is often higher than is ideal for composting.

5.1.1 Colorado Heartland Biogas project

In 2005, A1 Organics in Colorado purchased a DODA Bio Separator. The unit removes contaminants and produces a 10-12% food waste slurry according to Bob Yost, Vice President and Chief Technical Officer of A1 (Goldstein, 2015). The slurry is then transported to the Heartland Biogas project.

> “A1 Organics is responsible for delivering food waste, fats, oils and grease, and other non-manure substrates to the digester facility, and working with Heartland to develop high-value organic amendments and fertilizer grade products from the digested solids and liquid residuals. The complete mix anaerobic digester is located near a large dairy, and will digest manure in addition to the off-farm substrates.”
>
> - Nora Goldstein, Depackaging Feedstocks for AD and Composting, 2015

An additional depackaging system was then purchased to handle more of the lighter materials that the DODA was unable to separate. The Tiger HS640 Food De-packager uses an auger and hopper system to remove organics from their packaging. Using the two systems allows the company to make value-based judgement calls on what depacker is most economical for the organic materials.

5.1.2 Kroger Circular System

The Kroger chain of grocery stores in the United States have set corporate environmental stewardship goals, with a target year of completion of 2020. They aim to be a “zero waste company by 2020” According to their 2018 Sustainability report the company was able to divert 77% of generated waste from landfill disposal. The company has eight waste management methods to achieve this diversion rate. A table summarizing these methods are shown below.

WASTE MANAGEMENT METHOD	WEIGHT (SHORT TONS)
Waste Reduction	97,000
Food Donation	55,000
Animal Feed	72,400
Composting	42,400
Recycling	1,923,800
Anaerobic Digestion	34,800
Waste-to-Energy	38,100
Landfill	639,700
Total	2,903,300

1. Waste disposal is managed by and reported to Kroger by our different waste and recycling haulers.
2. Waste data excludes select retail stores (e.g., Roundy's division) and office locations. Data reflects calendar year 2017.

Figure 7: Kroger's Waste Diversion 2017 (Kroger, 2018)

As previously mentioned in the jurisdictional review, the company has depackaging systems in place to support one of their newer ventures in waste diversion, anaerobic digestion. There are currently two facilities with anaerobic digesters in operation, one in California, and another in Indiana. Both of these systems are located at the grocery chain's distribution centre and serve as not only a means of diverting waste from landfill disposal, but also as an energy generator to help run the facilities.

As you can see from Figure 7, anaerobic digestion is not their primary focus for waste diversion, recycling, waste reduction and animal feed makes up 72% of the waste diverted by the company in 2017.

5.1.3 Sainsbury's Circular System

Sainsbury's is a grocery chain in the UK that is using a similar model to that of Kroger.

5.2 Cost-Benefit Analysis

In the 2017 Nova Scotia Waste Audit, there was 10,608 tonnes of non-diverted food waste in the HRM. For the estimate, we set a capture rate of 50%, for increased recovery of 5,304 tonnes of organic waste. Supermarket and grocery store waste were estimated using the EPA Food Waste Estimator, with an amount of 11,402 tonnes per year. An initial goal of 20% capture of this amount would set collection at 1,824 tonnes per year (40% of the population in HRM, with a 40% capture of the HRM ICI waste). This yielded a total estimate of 7,128 tonnes per year. This value is the amount used for the cost-benefit shown in this report (as shown in Table 4), however, if a minimum amount of 1,285 tonnes of waste is processed, the project would reach breakeven at 15 years (as shown in Table 5), not including carbon offset.

The cost-benefit for the estimated value is shown in Table 2, with the minimum amount for positive breakeven shown in Table 3.

The EPA CoEAT estimator was used to calculate the carbon offset amount of 164.62. This value is based on the US national average for a temperate, wet climate, according to the Climate Action Reserve's Organic Waste Digestion (OWD) protocol. The monetary value of $30 per tonne was found on carbonzero.ca, yielding an annual value of $4,938.60.

An estimated price of $115 per tonne of compost material was used to value the de-packaged organic matter. This value was based on the findings of the 2017 report done by LP Consulting "Creating an Agricultural Market for Nova Scotia Compost". They showed that the price range for quality compost in the province is between $90-140 per tonne, we used the median for our estimation. It should be noted, however, that the product produced from the depackaging equipment is said to be very high quality, with a less than 1% inorganic contamination, suggesting that it may garner the higher sale price.

The avoided tipping fee was calculated using the County of Colchester's tipping fees. The cost of garbage or landfill disposal in the county is $113 per tonne for commercial and town residents, compared to $51 per tonne for compost disposal. The rate of $62 per tonne was therefore assigned as the avoided tipping fee cost. Additionally, the cost of feedstock transport was estimated at $10 per tonne.

Labour for the operation of the machinery was estimated to require 1-2 employees, with an estimated cost of $100,000 each including salary and benefits.

A discounting and financing rate of 8% was used in the cost-benefit analysis by the Government of Canada's Cost-Benefit Analysis Guide.

The equipment being used for the cost estimate is provided through Scott Equipment. The American industrial equipment manufacturers have a recycling product division that has a wide array of machines to handle a variety of products. Following a discussion with a representative, it was recommended that the Turbo Separator T30 (shown in Figure 8) would best suit the needs of the project as it can handle mixed grocery products and the organic material output can be used for animal nutrition, composting, and anaerobic digestion. Based on the industry standard, if properly used and maintained, the equipment should last for 25-30 years. A recommended plant layout was provided by the company and is shown in Figure 9.

Scott Equipment provided an estimate of $200 000 USD ($263 048 CND) for the Separator, infeed hopper, the platform, control panel, and waste packaging conveyor. While they do not include installation, assembly typically takes three to five days. Maintenance and operating cost were estimated at 10% of the equipment cost, with installation at approximately 20% of equipment cost. It was assumed that the equipment could be added to an existing facility, although it should be noted that some modifications may be required to house the system.

Figure 8: T30 Separator Food Waste Depackaging, Scott Equipment

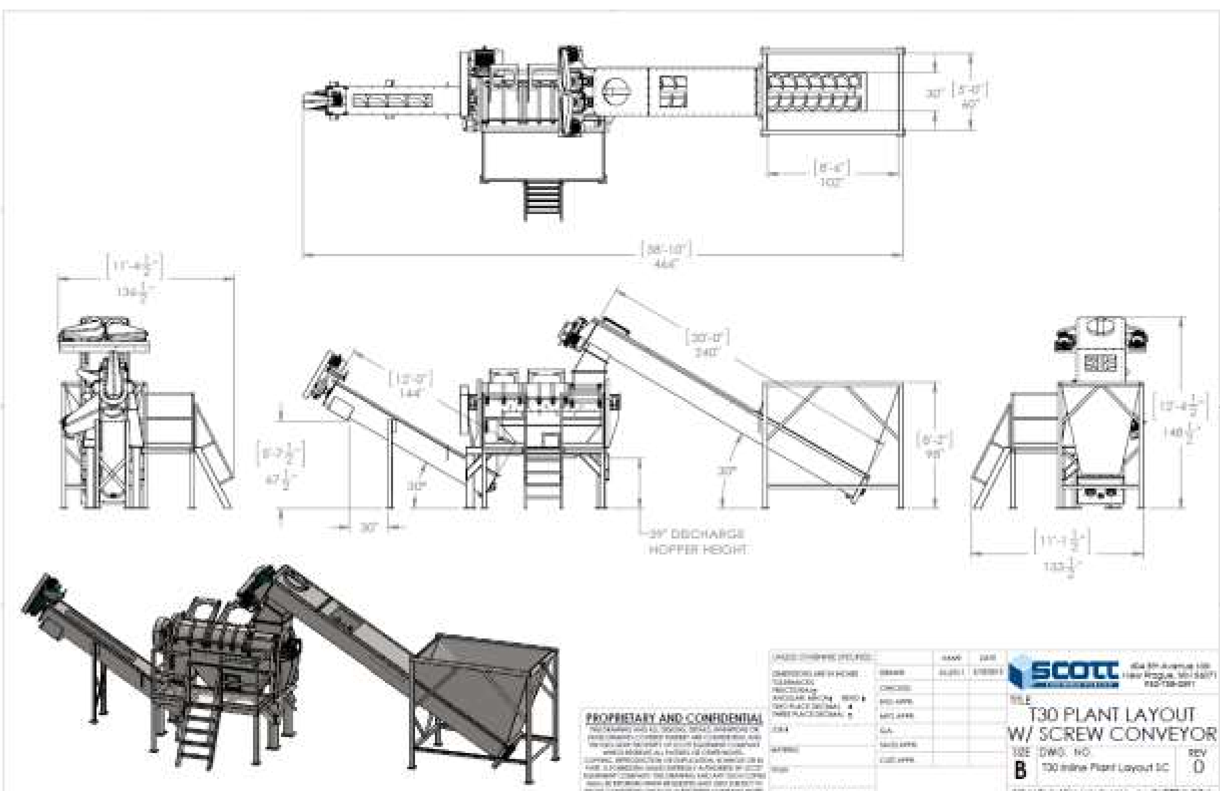

Figure 9: Suggested plant layout for T30 Separator

5.2.1 Cost-Benefit A- At estimated food waste amount

Table 5: CBA for Depackaging at estimated waste amount

<u>Project Costs</u>	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Capital Costs																
De-packer Equipment	$ 273,570	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659
De-packer Installation	$ 52,610	$ 52,610	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Facility and land use Cost	$ 924,424	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Recurring Costs																
Feedstock Access	$ -	$ -														
Feedstock Transport	$ 658,929	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280	$ 71,280
Labour	$ 1,848,847	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
Equipment Maintenance	$ 243,170	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305
Total Cost ($)	$ 3,946,688	$ 473,854	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244	$ 421,244
<u>Project Benefits</u>	NPV															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Savings																
Carbon Offset	$ 74,079	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60	$ 4,938.60
Avoided Tipping Cost	$ 6,629,040	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00	$441,936.00
Compost	$12,295,800	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720	$819,720
Total Benefit ($)	$18,998,919	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595	$ 1,266,595
NET BENEFIT OF PROJECT	**$15,052,231**	**$ 792,741**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**	**$ 845,351**
landfilled organic waste for composting	5304	capturing half of the HRM non diverted food waste														
ICI food waste	1824	capturing 20% of ICI food waste														
Feedstock for depacker	7128															
	$ 819,720															
Average benefit	Period months	Payback period years														
$ 105,550	37.39	3.12														

Table 2 above shows a swift payback period of fewer than 38 months for the project, with a net benefit of the project of just $15 million over 15 years.

5.2.2 Cost-Benefit B: Breakeven at 15 years

Table 6: CBA for depackaging at 15 yr breakeven waste amount

Project Costs	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Capital Costs																
De-packer Equipment	$ 273,570	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659	$ 23,659
De-packer Installation	$ 52,610	$ 52,610	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Facility and land use Cost	$ 924,424	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Recurring Costs																
Feedstock Access	$ -	$ -														
Feedstock Transport	$ 118,788	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850	$ 12,850
Labour	$ 1,848,847	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
Equipment Maintenance	$ 243,170	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305	$ 26,305
Total Cost ($)	$ 3,406,547	$ 415,424	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814	$ 362,814

Project Benefits	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Savings																
Carbon Offset	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Avoided Tipping Cost	$ 1,195,050	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00	$ 79,670.00
Compost	$ 2,216,625	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775	$147,775
Total Benefit ($)	$ 3,411,675	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445	$ 227,445
ET BENEFIT OF PROJECT	**$ 5,128**	**$ (187,979)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**	**$ (135,369)**
Feedstock for depacker	1285															
	$ 147,775															
Average benefit	Payback Period months	Payback period years														
$ 18,954	179.73	14.98														

Table 3 depicts the minimum amount of organic matter being processed through the de-packager to have a net positive for the project over 15 years. This estimate does not include the value of the carbon offset, as the CO2eq estimator was not able to reach this same amount of feedstock. Therefore the net benefit would be higher than what is shown, given that that social/environmental benefit was not accounted for.

6 Recommendations and Further Research

This report concludes that the depackaging equipment available would be a feasible addition to an existing waste management process if the province shifts to include anaerobic digestion in the recovery stream. This pre-processing step is highly recommended. The cost-benefit shows that the equipment can be profitable within a composting system as well and perhaps adopting depackaging machines first would be a means of building infrastructure for additional uses for the organic materials collected.

It should be noted, that successful prevention of food waste would mean that there would no longer be enough feedstock material to operate the system. Through continued efforts at every level of the food waste hierarchy, ideally the food waste available for depackaging would decrease, eventually rendering the system no longer feasible. Given the barriers at the higher levels of the hierarchy, this large decrease on available feedstock is likely several years away but should be the overall goal.

While the depackaging equipment shows itself to be an effective way of recovering food waste, it is important to mention again that recovery is not the ideal step in the hierarchy. We should ideally try to prevent or re-use the food waste, before trying to recover it. Given that food waste is now a global policy issue, more and more attention will fall not only on those who are attempting to solve the problem but also on those generating the waste. Public pressure has already caused shifts within our supermarket chains. This pressure will lead to innovation and collaborative solutions at the higher levels of the waste hierarchy.

A review of Stericycle.com (particularly the Canadian Operations area) informs us that Stericycle not only collects and redistribute packaged food from retailers to Food Banks and organizations like Feed Nova Scotia throughout Canada and other countries, but they also repurpose food which is not suitable for human consumption. Stericycle processes such food into animal feed and when that is not possible uses higher level processes to get the best use from the waste.

Additional Recommendations

Considerations should be made for adopting a bill/policy similar to that of the other Atlantic provinces in the form of a Food Donation Care Act. Such an act would be an important step to alleviate any barriers, excuses, or concerns regarding liability for retailers.

A final recommendation would be to continue working with retailers and provide them with the resources they need to make a change within their organization. While retailers may not be the largest generator of food waste, they hold a large amount of influence within the food supply chain. Consulting with them on their needs, as well as connecting them with resources they may not be aware of, such as new apps for stock management or food redistribution, is needed.

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8 APPENDIX: DEPACKAGING EQUIPMENT INFORMATION

8.1 ECRUSOR

VEOLIA

Ecrusor™
Depackaging System
Transforming Waste to Resource

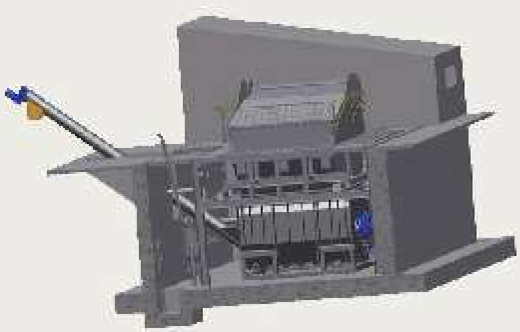
Solution for depackaging and preparing biodegradable wastes for energy generation

The Process

Ecrusor™ is the ideal solution to turn food waste and other wastes high in caloric value into useful energy. A compact and robust process, Ecrusor depacks food waste from its packaging in order to extract the organic material. Inert waste packaging material is sent one direction; energy-rich organic material is macerated and sent another. The patented process creates a homogenous mixture of liquid and solid organics that can then be conveyed to an anaerobic digester to produce biogas. Using CHP or other tools, this biogas can then be converted into energy for use at the facility or for sale back to the grid. Ecrusor thus helps turn waste treatment facilities into revenue-generating resource recovery facilities in a circular economy approach.

Simple Operation

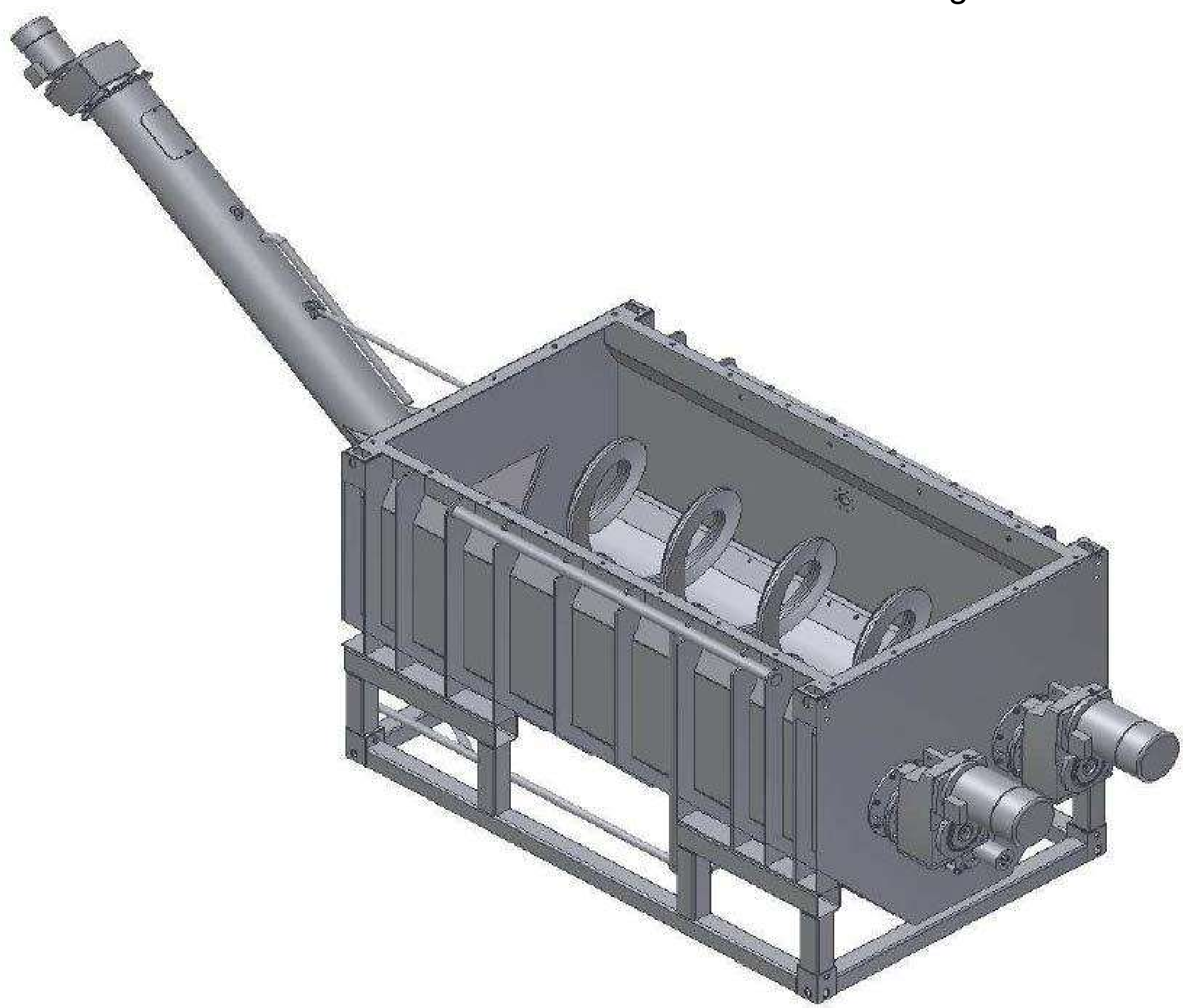
Packaged or unpackaged waste is dumped into Ecrusor's receiving hopper. In Ecrusor, the bulk packaged waste is first broken apart, separating inorganic waste from the organic material. This is done with spiral grinding screws that move forwards and backwards, agitating, distributing, and breaking apart the waste. Ecrusor has an end plate that is equipped with a number of chopping/cutting teeth which facilitate the destruction of the inert packaging material without making it so small that it could pass through the effluent perforated plates. The perforated plates thus retain the inert material but allow the pureed organic material to pass on to digestion.



WATER TECHNOLOGIES

Ecrusor-1000

Equipment
for crushing, depackaging and sorting
biodegradable waste



Veolia Water Technologies, Inc.
dba Kruger
4001 Weston Parkway * Cary, NC 27513
tel. +1 919-677-8310 • fax +1 919-677-0082
www.veoliawatertech.com

1. Technical Characteristics

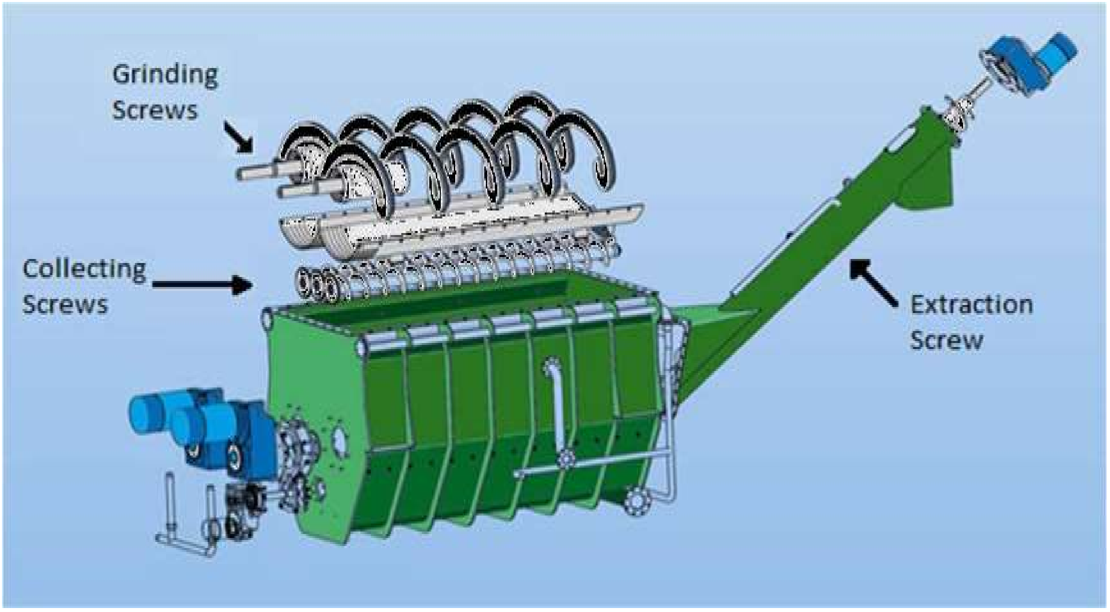
Nominal Treating capacity	0-176 gpm
Model Name	**Ecrusor-1000**
Electrical Equipment	460V, 60 Hz, 3ph
Construction Materials	Modules on a skid made of carbon steel
Separation Typology	Crushing, depackaging and sorting
Phase Separation	Organic and inorganic material
Control	Standardly Manual operation, but can be equipped with PLC for automation
Noise	< 75 dBa
Patent References	Protocol n. PCT/HU 2008/000030 EP08719114.4 2008 March 27
Supply	NEMA 4x

2. Nominal Performance

Model Name	**Ecrusor-1000**
Electrical Equipment	460V, 60 Hz, 3ph
Nominal Treatment Capacity	0-176 gpm ± 10%
Installed Power	71 hp
Absorbed Power	35 - 56 hp ± 10%
Power Factor	1
Specific Consumption (Electrical Power per cubic meter product treated)	0.2 - 0.32 [hp/gpm] ± 10%

3. Functional Description

Packaged or unpackaged food waste is dumped into the Ecrusor's receiving hopper. In the Ecrusor, the organic waste is first broken apart, separating inorganic waste from the organic material. This is done with spiral grinding screws that move forwards and backwards, agitating, distributing, and breaking the waste apart. The Ecrusor has an end plate that is equipped with a number of chopping/cutting teeth which facilitate the destruction of the packaging material (unwanted material) without making the packaging material small enough to pass through screens and the release of the desired organic material, which is further pureed.



Two 8 mm perforated plates located below the grinding screws separate the organic and inorganic material. The grinding screws puree the organic material allowing for the organics to pass through the perforated plate to three collection screws that convey the organic slurry out of the unit. The unusable inert (inorganic) packaging waste remaining on the perforated plates and is removed with an extraction screw. Residual organic matter on the inert packaging material is washed off as it moves up and out of the extraction screw. The washed inert waste is collected in waste container (to be transported off-site).

Once separated, the organic slurry is pumped to the plants existing sludge treatment (e.g. anaerobic digestion) for anaerobic conversion of the organics into biogas (methane).

The Ecrusor can handle all types of packaging including glass, large fruit pits and wood. However excessive glass and wood would result in hastening the wear and tear of downstream positive displacement pump stator.

Ecrusor is capable of processing up to 52 cubic yards of food waste every hour.

3.1 Types of Process Waste

The waste processing unit is responsible for the delivery and processing of waste with independent physical characteristics, grinding and sorting in one unit.

Materials of liquid form can be unpackaged by the Ecrusor:

- Sewage liquid with 1-30% of dry solids
- Non-packaged dairy waste
- Portable water, septic tank sewage, dewatered cake from other facilities

Packaged and expired products:

Dairy products
Meat products
Confectionary industry, manufacturing residuals
Bakery wastes, including uncooked and cooked dough Expired Soft drinks
Expired Food products
Waste from grocery chains
Waste from cafeterias, restaurants, commercial kitchens
Restaurant, household, and kitchen wastes where available
Landfill diverted organics

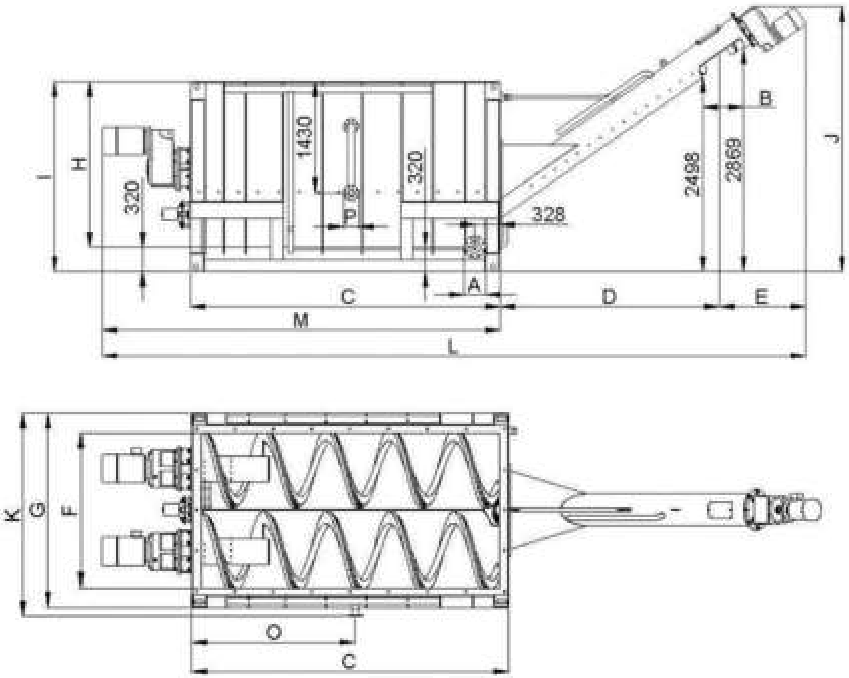
4. Additional Options

I. Control Panel for Automated Control
II. User Interface HMI
III. SCADA integration
IV. Advanced Safety Controls
V. Remote Monitoring via Vision

5. Materials of Construction

Component	**Ecrusor-1000**
Discharging non-biodegradable waste screw	Carbon Steel
Crushing and sorting Screws	Carbon Steel
Organics Collection Screws	Carbon Steel
Perforated Screen	Hardox
Main Chamber	Carbon Steel

6. Dimensions and Clearance Zones



	Ecrusor-1000
A	6", 150 lbs
B	14.6" x 20.8"
C	13.1'
D	9.3'
E	3.7'
F	6.4' x 12.3'
G	8'
H	6.9'
I	8'
J	11.2'
K	8.4'
L	29.8'
M	16.9'
O	6.8'

7. Dimensions, Weight, Packaging, Storage and Handling

Ecrusor-1000

Type	**Dimensions (feet)**	***Weight (tons)***
Standard Packaging	8' x 8.3' x 30'	
Empty Assembled Unit / Loaded Unit		*10.8 / 51.8*

A forklift or crane must be able to lift and move every single part.

8. Working Temperature

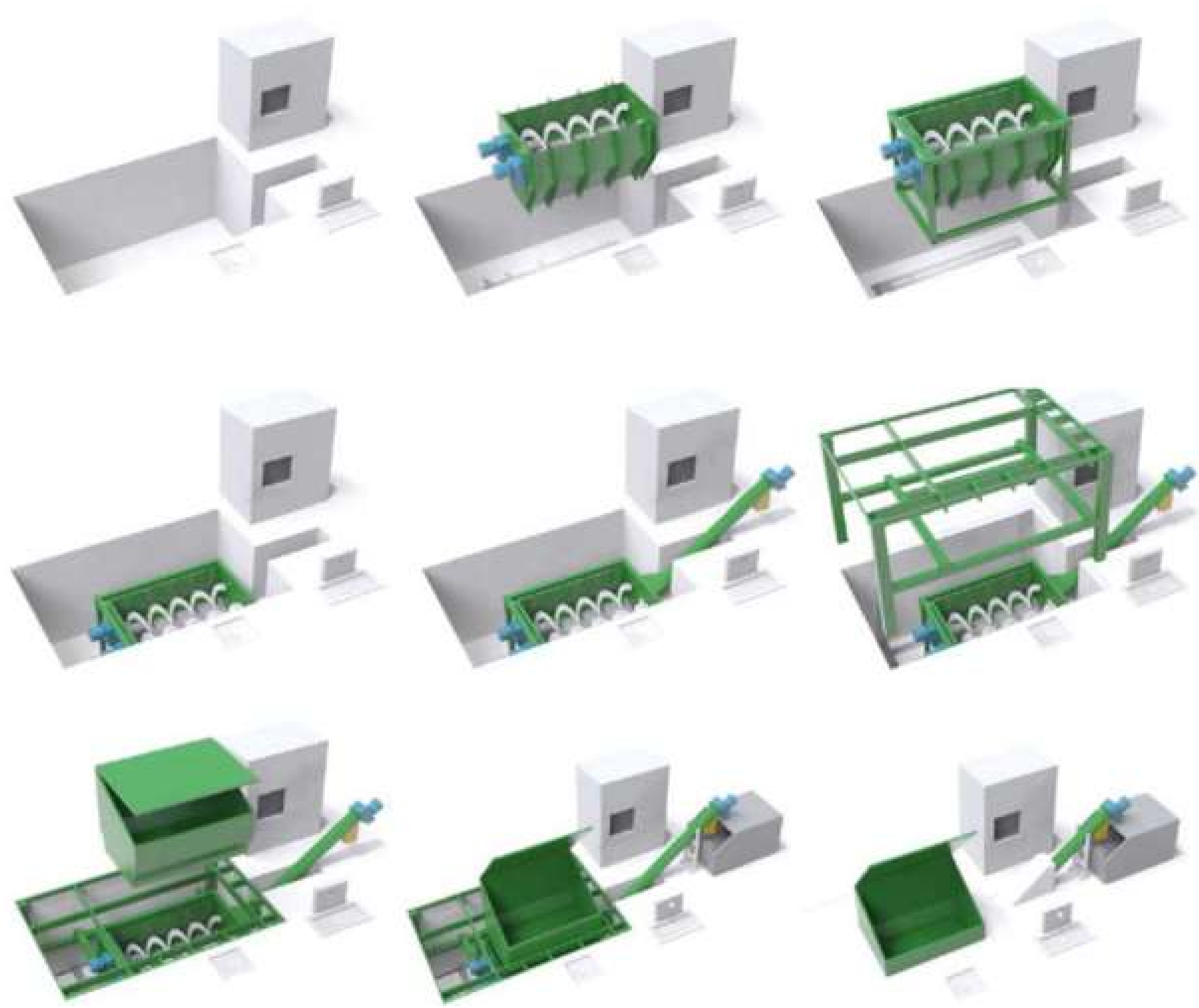
The installation ambient temperatures allowing the correct working of the unit are detailed in the following table:

Ambient Temperature	**Working Conditions**
Normal Conditions	41-113 °F (5-45 °C)
Startup Allowed only with precautions	< 41 °F (5 °C)
Made Precautions for the electrical Components	> 113 °F (45 °C)

The humidity at ambient temperatures must be between 30% and 90%.

9. Installation Requirements

The machine must be installed in a level position in a location that can support the weights listed in Section 7. Installation of the Ecrusor is simply detailed in the figure below.



Clearances around the Ecrusor must be considered in order to allow personnel and the maintenance operators to work free of obstacles.

The following is a list of connections to the Ecrusor system.

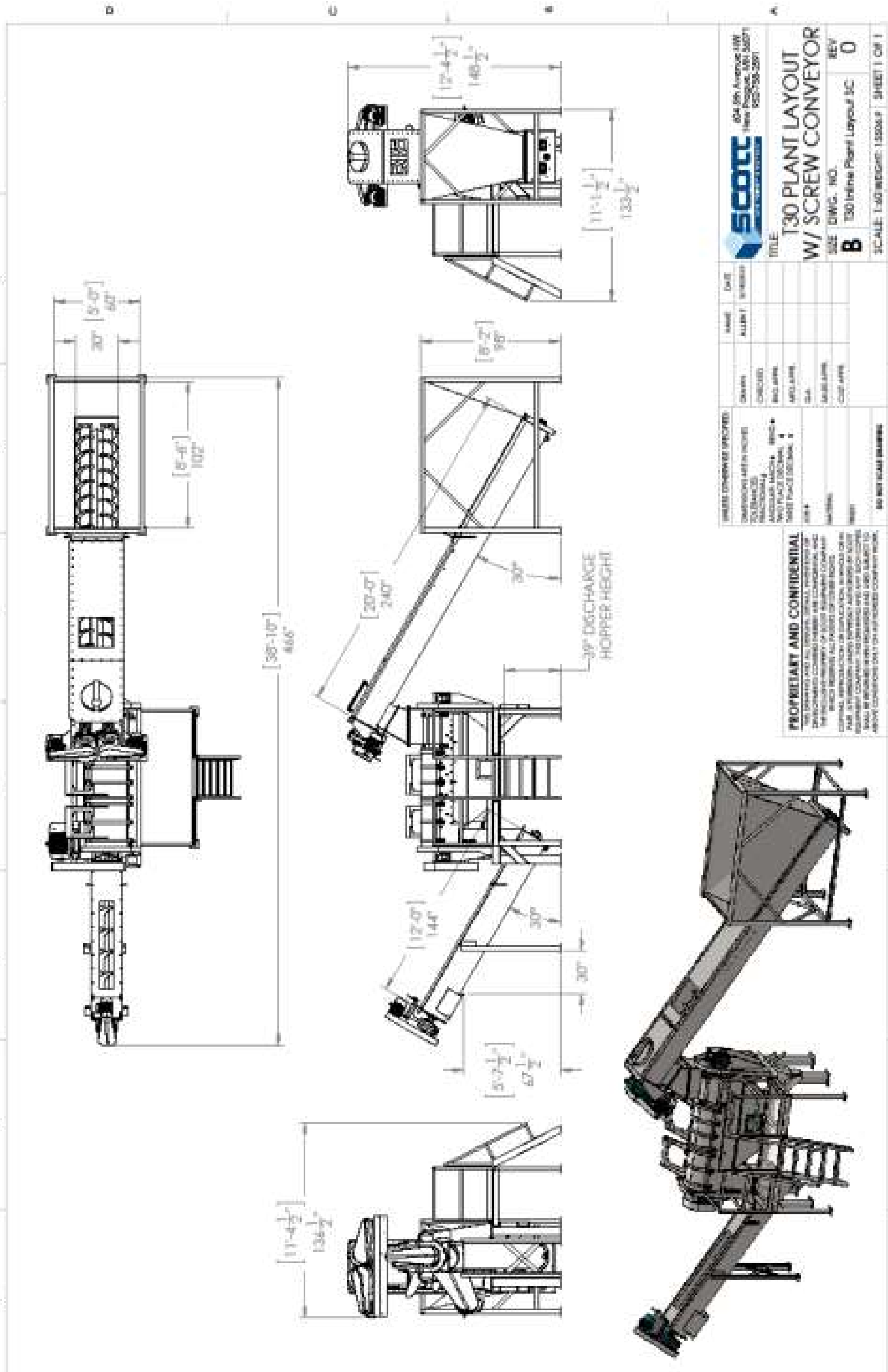
			Ecrusor-1000
No.	Description	Type	Inches
1	Waste to be treated	Open Tank	
2	Liquid water discharge	Flanged	2x 8"
3	Solid inorganic discharge	Pipe	16"

The Ecrusor requires water at 68-104°F (20-40°C), at 75psi, and at 35 gpm.

The nominal total current is 110A. This current is to be used for cable sizing and for protection of the system. The electric scope of work is the responsibility of owner and need to be connected and installed by a qualified/certified technician.

If the unit must work in an environment with temperatures below 32°F (0°C), it is necessary to arrange a covering for the unit in order to avoid ice buildup in the unit. Ice could alter the operation of the unit resulting in downtime.

8.2 SCOTT TURBO T30 SEPARATOR


T30 PLANT LAYOUT
W/ SCREW CONVEYOR
PROPRIETARY AND CONFIDENTIAL
39" DISCHARGE
HOPPER HEIGHT
[38'-10"]
466"
[20'-0"]
240"
[12'-0"]
144"
[8'-6"]
102"
[8'-2"]
98"
[5'-0"]
60"
30"
B
0

8.3 Depackaging Equipment

BUYERS' GUIDE

BUYERS' GUIDE

A variety of depackaging options are available to operators

the quality of outputs is likely to be higher if a less variable input is introduced to the technology. Where the food industry uses such technology in-house to process off-spec and spoilt foods, there is an opportunity to maximise recovery and quality by batch feeding specific product ranges which may include only a single or a limited range of packaging material types.

Any degree of source segregation

TABLE 1: DEPACKAGING EQUIPMENT		
DEPACKAGING EQUIPMENT		
	PRODUCT A	**PRODUCT B**
Company name	**Atritor Limited**	
Address	Edgewick Park, Canal Road, Coventry, CV6 5RB	
Tel	+ 44 2476 662266	
Website	www.turboseparator.co.uk	
Contact name	Mark Hulme	
Email	mhulme@atritor.com	
Model name/code	Turbo Separator TS2096	Turbo Separator TS3096
Types of food/beverage handled *	Beans, cigarettes, dedorants, processed, meats, soups, toothpaste, beverages, coleslaw, detergents, pasta, potato chips, sugar, biscuits, coffee, gravy, granules, pet foods, powdered milk, tea, baby foods, cosmetics, household products, sachets, pharmaceuticals, vegetables, cereals, custard, insecticides, sauces, flour, yoghurt, soap powder, shampoo, oil, paint, plasterboard and many more	
Types of packaging handled **	Tin cans, tin trays, plastic bottles, soft packaging, aluminium cans, sachets, pouches, polymer bags, paper bags, Tetra Pak, boxed products, plastic containers, steel drums, plastic drums, trays, blister packs, tubes, cartons, plastic jars, & cardboard containers	
Dimensions (mm)	System dependent	
Throughput capacity (m3/hr)	Material dependent	
Separation efficiency (%)	Up to 99%	
Speed (rpm)	Variable	
Power requirements (kW)	22kW (machine only)	37kW (machine only)
Base package includes	TS2096 in-feed conveyor/separated packaging conveyor/recovered material conveyor/recovered material pump & macerator	
Fabrication	Carbon steel or stainless steel available	
Delivery time (approx)	Dependent on system	
Guarantees provided by supplier		
Capital cost range (£ excl VAT)	£60,000 up to £115,000	£75,000 up to £130,000
Operating cost per annum for maintenance & consumables, estimate (£ excl VAT)	£2.50 per/hr based on £0.10 per kW/hr	£3.50 per/hr based on £0.10 per kW/hr
Operating cost per annum for maintenance & consumables, estimate (% of purchase	3% dependant on product	

TABLE 1: DEPACKAGING EQUIPMENT

DEPACKAGING EQUIPMENT

	PRODUCT A
Company name	Brand GmbH
Address	Aeussere Speicher Str. 1
Tel	0049 3525 513697
Website	www.ha-di-tec.com
Contact name	Mr. Brand
Email	info@ha-di-tec.com
Model name/code	Food Waste Processing Line
Types of food/beverage handled *	All
Types of packaging handled **	Excluded pallets all
Dimensions (mm)	15x20 m
Throughput capacity (m3/hr)	6 to 8 tons/hour
Separation efficiency (%)	95 to 99 %
Speed (rpm)	
Power requirements (kW)	About 80 Kw
Base package includes	(E.g. machine, support and controls)
Fabrication	(material and grade)
Delivery time (approx)	2 to 3 months
Guarantees provided by supplier	6 to 12 months
Capital cost range (£ excl VAT)	289.000,00 Euro
Operating cost per annum for maintenance & consumables, estimate (£ excl VAT)	Depending to input materials
Operating cost per annum for maintenance & consumables, estimate (% of purchase price)	Very low separating cost per ton
Required sercice intervals (monthly or annually)	Depending input materials

Many food items are wasted without being opened, therefore, robust depackaging solutions are required

8.4 RECYCLING WORKS MASSACHUSETTS

RECYCLINGWORKS
MASSACHUSETTS

SUMMARY of FOOD DE-PACKAGING TECHNOLOGIES

November 2014

The Massachusetts commercial organics waste disposal ban, which applies to all businesses and institutions disposing of one ton or more of food waste per week, took effect on October 1, 2014. There are many cost effective ways facilities can comply with the new commercial food waste ban. Delivering food waste to an off-site composting or anaerobic digestion facility through a hauler is a common strategy, but other options include donating surplus food, reducing waste through purchasing controls and production modifications, and exploring technologies to manage and process food waste on site.

Packaged food is included within the definition of commercial organic material as defined under the new waste ban, and the packaging itself may also fall subject to an existing waste ban. More specifically, packaging types such as cardboard, paper, certain plastics, and metal are covered under existing waste bans in Massachusetts.

When managing packaged food waste, it is important to first assess available options for pre-processing and diverting packaged food from disposal. These options may include donating surplus packaged food to organizations in your community, sending the material to an off-site depackaging facility, and investing in on-site depackaging technology. On-site depackaging technologies may be used as a preliminary materials separation step prior to traditional on or off-site food waste and recyclable materials processing. The document is intended to provide additional information on available on-site depackaging technologies for packaged food waste management.

The data in this document is organized into an overview table followed by system-specific forms. In order to provide a concise summary of the technologies included, the overview table lists all submitted on-site systems with a subset of product information. Following the overview, the system-specific forms provide more in-depth information about each product and company contact information. These system-specific forms are presented in alphabetical order by company name and match the order in which they are listed on the overview table.

All company and product information provided in this document was obtained from manufacturers or distributors of the various technologies represented. No substantive edits have been made to this information beyond consolidating and editing it for formatting purposes. Listing in this document does not constitute endorsement by MassDEP or by RecyclingWorks in Massachusetts, and the information included has not been verified by MassDEP or RecyclingWorks in Massachusetts. Businesses and institutions interested in on-site depackaging systems are encouraged to use the contact information provided in this document and research the best system for their individual needs. RecyclingWorks in Massachusetts will update this document in the future as additional information becomes available.

For more information and resources on starting a food waste diversion program, visit the RecyclingWorks website at www.recyclingworksma.com. If you need help at any point, please call the hotline at (888) 254-5525 or email info@recyclingworksma.com to reach a recycling expert.

For more information on MassDEP waste ban regulations and assistance, view additional guidance on the MassDEP website here. For specific inquiries, please contact John Fischer at (617)292-5632 or john.fischer@state.ma.us.

If you are a manufacturer or vendor of on-site organic waste management technology and would like your information to be added to this document contact RecyclingWorks at (888) 254-5525 or info@recyclingworksma.com.

Overview of listed on-site food depackaging technologies

(Listed alphabetically by company name)

	Company Name	Model Name	Food Material Types	Packaging Types	Capacity	Separation Efficiency (%)	Price Range (USD)
1	**Brask Enterprises**	High Density Extruder	Wet food waste and liquids	Paper, plastic, aluminum, tin, steel, etc.	Varies	Liquid extraction rates up to 98% and volume & weight reductions up to 90%	Varies
2	**Brask Enterprises**	Xcycler	All	Varies	Varies	Varies	Varies
3	**Brask Enterprises**	Xtractor	Liquids	Plastic, tin & aluminum cans, and paper based containers	Up to 8 yd³/hour (Over 12 yd³/hour of aluminum cans)	Weight reduction up to 97% & volume reduction up to 95%	Varies
4	**Ecoverse (Doppstadt US)**	Tiger HS 640	Post consumer food waste, packaged foods, cafeteria waste, industrial food production rejects.	Cans, metal, plastic, paper, tetra pack, cardboard, plastic wrap, bags, etc.	9 tons/hour	98%	460,000
5	**JWCE**	ZWM (ZWM40xx/ ZWM30xx)	Liquids, dairy (i.e. milk, yogurt), canned foods, boxed foods	Cardboard, plastic bottles, metal cans	205 ft³/hr (5.8 m³/hr)	Varies	$100,000 – 125,000+
6	**Scott Equipment Company**	Turbo Separator	All	All	0 to 25 tons/hour	90% or greater	$125,000 - $245,000 (typical)
7	**Sebright Products, Inc.**	High Density Extruder	Wet food waste and liquids	All	Up to 28 yd³/hour	See literature online	$70,000 - $500,000
8	**Sebright Products, Inc.**	X3Cycler	Liquid products	Aluminum cans and plastic bottles	Up to 30 yd³/hour (Up to 1,200 lbs of PET per hour)	Volume reduction up to 95%	$70,000 - $500,000
9	**Sebright Products, Inc.**	Xtractor	Liquid products	Aluminum cans, plastic bottles and other liquid containers ranging from 0.5 to 4 liters	10 yd³/hour (7.5 m³/hour)	Weight reduction up to 93% & volume reduction up to 90%	$70,000 - $500,000

Company Information	
Company Name	**Brask Enterprises**
Address	PO Box 551 ATTLEBORO, MA 02703
Phone	800-848-8805
Website	www.brask.com
Contact Name	Tom Robinson / Keith Brask
Email	trobinson@brask.com
Technical Specifications	
Model Name and Number	High Density Extruder
Food Materials Accepted	Wet food waste and liquids
Packaging Materials Accepted	Paper, plastic, aluminum, tin, steel, etc.
Operation Method	Varies by machine.
Capacity (tph)	Varies by machine.
Separation Efficiency (% of food material separated)	Liquid extraction rates up to 98% and volume & weight reductions up to 90%
Power Requirements	Varies by machine.
Dimensions	Varies by machine.
Fabrication	Varies by machine.
Cost and Delivery	
Warrantee or Guarantee	
Equipment Price Range (USD)	Varies by machine.
Installation Cost (USD)	Varies by machine.
Required Service Interval	Varies by machine.
Estimated Maintenance Cost (USD)	Varies by machine.
Annual Operating Cost (USD)	Varies by machine.

Company Information	
Company Name	**Brask Enterprises**
Address	PO Box 551 ATTLEBORO, MA 02703
Phone	800-848-8805
Website	www.brask.com
Contact Name	Tom Robinson / Keith Brask
Email	trobinson@brask.com
Technical Specifications	
Model Name and Number	Xcycler
Food Materials Accepted	All
Packaging Materials Accepted	Varies by machine.
Operation Method	Varies by machine.
Capacity (tph)	Varies by machine.
Separation Efficiency (% of food material separated)	Varies by machine.
Power Requirements	Varies by machine.
Dimensions	Varies by machine.
Fabrication	Varies by machine.
Cost and Delivery	
Warrantee or Guarantee	
Equipment Price Range (USD)	Varies by machine.
Installation Cost (USD)	Varies by machine.
Required Service Interval	Varies by machine.
Estimated Maintenance Cost (USD)	Varies by machine.
Annual Operating Cost (USD)	Varies by machine.

Company Information	
Company Name	**Brask Enterprises**
Address	PO Box 551 ATTLEBORO, MA 02703
Phone	800-848-8805
Website	www.brask.com
Contact Name	Tom Robinson / Keith Brask
Email	trobinson@brask.com
Technical Specifications	
Model Name and Number	Xtractor
Food Materials Accepted	Liquids
Packaging Materials Accepted	Plastic, tin & aluminum cans, and paper based containers
Operation Method	Varies by machine.
Capacity (tph)	Up to 8 cubic yards per hour (Over 12 cubic yards of aluminum cans per hour)
Separation Efficiency (% of food material separated)	Waste weight reduction of up to 97% and waste volume reduction of up to 95%
Power Requirements	Varies by machine.
Dimensions	Varies by machine.
Fabrication	Varies by machine.
Cost and Delivery	
Warrantee or Guarantee	
Equipment Price Range (USD)	Varies by machine.
Installation Cost (USD)	Varies by machine.
Required Service Interval	Varies by machine.
Estimated Maintenance Cost (USD)	Varies by machine.
Annual Operating Cost (USD)	Varies by machine.

COMPANY INFORMATION	
Company Name	**Ecoverse (Doppstadt US)**
Address	1265 Lear industrial Pkwy
Phone	440.937.3225
Website	http://ecoverseindustries.com/
Contact Name	Darren Finlay
Email	darren@doppstadtus.com
TECHNICAL SPECIFICATIONS	
Model Name and Number	**Tiger HS 640**
Food Materials Accepted	Post consumer food waste, Packaged Foods, Cafeteria Waste, Industrial Food Production rejects. Cans & Tin, Plastic, Paper, Tetra Pack (milk cartons), Shopping bags, Garbage bags.
Packaging Materials Accepted	cardboard, plastic wrap, plastic bottles, metal cans, etc.
Operation Method	The Tiger draws material into a vertical shaft mill through twin aughers. The material is shredded washed and sized through screens. Capturing 98% of organic material. The tiger can operate as a wet or dry unit.
Capacity (TPH)	9 tons per hour
Separation Efficiency (% of food material separated)	98%
Power Requirements	74.7 kw by 380 or 400 volt
Dimensions	7410 mm x 2500 mm x 4120
Fabrication	
COST AND DELIVERY	
Warrantee or Guarantee	1 year
Equipment Price Range (USD)	$460,000
Installation Cost (USD)	
Required Service Interval	
Estimated Maintenance Cost (USD)	
Annual Operating Cost (USD)	

Company Information	
Company Name	**JWCE**
Address	290 Paularino Ave, Costa Mesa, CA 92626
Phone	800-331-2277
Website	www.jwce.com
Contact Name	Aqua Solutions Inc Warren Brown - 508 317 2461
Email	wbrown@aquasolutionsinc.net
Technical Specifications	
Model Name and Number	**ZWM (ZWM40xx / ZWM30xx)**
Food Materials Accepted	Liquids, dairy (i.e. milk, yogurt), canned foods, boxed foods
Packaging Materials Accepted	Cardboard, plastic bottles, metal cans
Operation Method	Burst package open and spray wash with screen; separate liquids from solids
Capacity (tph)	205 ft^3/hr (5.8 m^3/hr)
Separation Efficiency (% of food material separated)	Varies - depending on material
Power Requirements	230v/460v/3ph/60Hz
Dimensions	
Fabrication	304ss material; installation by local distributor (factory trained)
Cost and Delivery	
Warrantee or Guarantee	1 year limited warranty
Equipment Price Range (USD)	$100,000 – 125,000+
Installation Cost (USD)	$3500 per day/1500 additional day
Required Service Interval	Grinder (3 -5 yrs); brush - 18 months
Estimated Maintenance Cost (USD)	Up to 10% of purchase price
Annual Operating Cost (USD)	n/a

Company Information	
Company Name	**Scott Equipment Company**
Address	605 4th Avenue NW, New Prague MN 56071
Phone	(413) 349-9491 - Corey Plucker @ EV New England (800) 264-9519 - Scott Equipment, Minnesota
Website	www.scottequipment.com
Contact Name	Corey Plucker - MA Local Representative with EV New England
Email	corey.evne@gmail.com pete.calderon@scottequipment.com
Technical Specifications	
Model Name and Number	**Turbo Separator**
Food Materials Accepted	All organic waste - mixed waste, single-type, packaged organic waste, organics contaminated with foreign material, industrial, commercial, residential, pre or post consumer, dry, liquid, slurry
Packaging Materials Accepted	All packaging types
Operation Method	The Scott Turbo Separator processes one incoming waste stream into two components - an organics stream for reuse (digestion, composting, etc.) - and a "contaminants" or packaging stream for further recycling, sorting, or disposal.
Capacity (tph)	0 to 25 tons per hour of infeed material
Separation Efficiency (% of food material separated)	90% or greater, variable based on the needs of each individual application
Power Requirements	Variable - 25 to 75 Horsepower
Dimensions	Variable 20" diam to 42" diam., 96" to 120" length Machine is custom designed for each application
Fabrication	Steel fabrication, indoor or outdoor installation Requires a suitable mounting surface
Cost and Delivery	
Warrantee or Guarantee	Typically 1 year
Equipment Price Range (USD)	Variable, depending on size, rate, system configuration and other options, typically ranging from $125,000 to $245,000 for equipment supply.
Installation Cost (USD)	Mechanical: Typically 25% of equipment cost Electrical: Typically 20% of equipment cost
Required Service Interval	Regular clean-out and preventative maintenance
Estimated Maintenance Cost (USD)	Varies based on material handled
Annual Operating Cost (USD)	Varies based on processing rate, HP and other system features.

Company Information	
Company Name	**Sebright Products, Inc.**
Address	127 N Water St, PO Box 296, Hopkins, MI 49328
Phone	319-389-5444 or 269-718-5732
Website	www.sebrightproducts.com
Contact Name	Gary Brinkmann
Email	Gary@sebrightproducts.com
Technical Specifications	
Model Name and Number	**High Density Extruder**
Food Materials Accepted	Wet food waste and liquids
Packaging Materials Accepted	All
Operation Method	Bales empty packaging while capturing remaining product for reuse or recycling
Capacity (tph)	Up to 28 cubic yards per hour
Separation Efficiency (% of food material separated)	See literature online
Power Requirements	See literature online
Dimensions	Length: 192 to 306" Width: 37 to 73" Height: 72 to 92"
Fabrication	See literature online
Cost and Delivery	
Warrantee or Guarantee	1 year parts and labor
Equipment Price Range (USD)	$70,000 - $500,000
Installation Cost (USD)	Application/facility specific
Required Service Interval	6 months - 1 year for base maintenance
Estimated Maintenance Cost (USD)	<10%
Annual Operating Cost (USD)	<10%

Company Information	
Company Name	**Sebright Products, Inc.**
Address	127 N Water St, PO Box 296, Hopkins, MI 49328
Phone	319-389-5444 or 269-718-5732
Website	www.sebrightproducts.com
Contact Name	Gary Brinkmann
Email	Gary@sebrightproducts.com
Technical Specifications	
Model Name and Number	**X3Cycler**
Food Materials Accepted	Liquid products
Packaging Materials Accepted	Aluminum cans and plastic bottles
Operation Method	Bales empty packaging while capturing remaining product for reuse or recycling
Capacity (tph)	Up to 30 cubic yards per hour (Up to 1,200 lbs of PET per hour)
Separation Efficiency (% of food material separated)	Container volume reductions of up to 95%
Power Requirements	30 Horsepower 230/460 V, 3 PH
Dimensions	Length: 222" Width: 85" Height: 155"
Fabrication	See literature online
Cost and Delivery	
Warrantee or Guarantee	1 year parts and labor
Equipment Price Range (USD)	$70,000 - $500,000
Installation Cost (USD)	Application/facility specific
Required Service Interval	6 months - 1 year for base maintenance
Estimated Maintenance Cost (USD)	<10%
Annual Operating Cost (USD)	<10%

Company Information	
Company Name	**Sebright Products, Inc.**
Address	127 N Water St, PO Box 296, Hopkins, MI 49328
Phone	319-389-5444 or 269-718-5732
Website	www.sebrightproducts.com
Contact Name	Gary Brinkmann
Email	Gary@sebrightproducts.com
Technical Specifications	
Model Name and Number	**Xtractor**
Food Materials Accepted	Liquid products
Packaging Materials Accepted	Aluminum cans, plastic bottles and other liquid containers ranging from 0.5 to 4 liters
Operation Method	Bales empty packaging while capturing remaining product for reuse or recycling
Capacity (tph)	10 cubic yards (7.5 M3) per hour
Separation Efficiency (% of food material separated)	Weight reduction of up to 93% and volume reduction of up to 90%
Power Requirements	7.5 kW (10 Horsepower) 460 V, 3 PH is recommended
Dimensions	Length: 157 9/16" Width: 48 1/2" Height: 78 5/8"
Fabrication	See literature online
Cost and Delivery	
Warrantee or Guarantee	1 year parts and labor
Equipment Price Range (USD)	$70,000 - $500,000
Installation Cost (USD)	Application/facility specific
Required Service Interval	6 months - 1 year for base maintenance
Estimated Maintenance Cost (USD)	<10%
Annual Operating Cost (USD)	<10%